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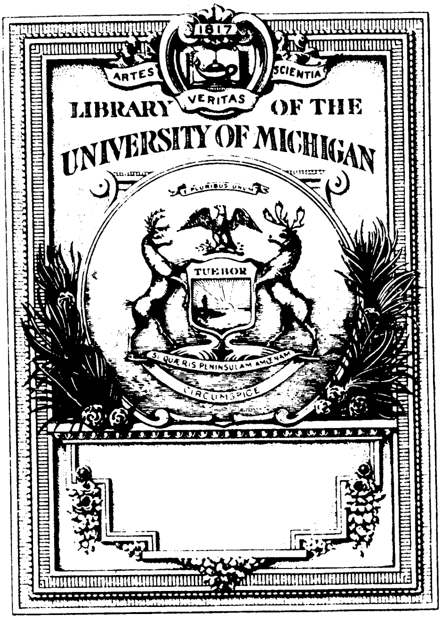
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FIFTH ANNUAL REPORT

OF THE

Philippine islands.

MINING BUREAU

TO THE

HONORABLE SECRETARY OF THE INTERIOR

BY

H. D. McCASKEY

CHIEF OF THE MINING BUREAU

FOR THE

YEAR ENDING AUGUST 31, 1904

MANILA
BUREAU OF PUBLIC PRINTING
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General

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FIFTH ANNUAL REPORT OF THE MINING BUREAU.

Department of the Interior, Mining Bureau,
Manila, September 15, 1904.

Sir: I have the honor to submit herewith the annual report of the Mining Bureau, being for the year ending August 31, 1904.

THE BUREAU REORGANIZED: PERSONNEL, PURPOSES, AND PLANS.

After having completed the work for which it was originally organized under the military occupation, as fully discussed in the last annual report of this Bureau, the Bureau was reorganized by the passage of Act 916, of the Philippine Commission, which act went into effect October 15, 1903.

Previous to the reorganization the first Chief of the Bureau, the Hon. Chas. H. Burritt, was appointed judge of the Court of First Instance, to preside over the Mountain District, and the undersigned, mining engineer, was appointed Chief of the Bureau to date from October 15. The present Chief took the oath of office on November 2, immediately upon his return from accrued leave in the United States, and proceeded at once to the reorganization authorized.

The functions of the Mining Bureau are prescribed in section 4, Act 916, which reads as follows:

> It shall be the function of said Bureau to make, facilitate, and encourage special studies of the mineral resources, mineral industries, and geology of the Philippine Islands; to collect statistics concerning the occurrence of the economically important minerals and the methods pursued in making their valuable constituents available for commercial use; to make collections of typical geological and mineralogical specimens, especially those of economic and commercial importance, such collections to constitute the museum of the Mining Bureau, subject, however, to transfer by executive order of the Civil Governor to any general museum established; to provide a library of books, reports, drawings, etc., bearing upon the mineral industries, the sciences of mineralogy and geology, and the arts of mining and metallurgy, such library constituting the library of the Mining Bureau; to make a collection of models, drawings, and descriptions of mechanical appliances used in mining and metallurgical processes; to preserve and so maintain such collections and library as to make them available for reference and examination, and open to public inspection at reasonable hours; to maintain, in effect, a bureau of information concerning the mineral industries of the Philippine Islands; to make an annual report to

the Secretary of the Interior setting forth the important results of the work of the Bureau, such special reports as may be called for by proper authority, and such bulletins concerning the statistics and technology of the mining industries and of the geological and mineralogical and other office and field-work of the Bureau, as may be approved by the Chief of the Bureau and ordered published by the Secretary of the Interior.

In order that the work outlined above may be properly carried out there are provided, by the act above noted, a permanent staff composed of a Chief of the Bureau, two geologists, and two field assistants, a temporary service of "such assistance from mining engineers, experts, and practical miners, or others, as the funds appropriated for the field work of the Bureau shall warrant," and the clerical force required. The Chief of the Bureau and the geologists "shall be graduates of recognized schools of mines or shall have received degrees in mining, metallurgy, or geology from reputable universities, or shall have successfully completed work in such schools of mines or universities equivalent in kind and amount to that for which such degrees are given;" and the field assistants shall be selected by standards equally high. The work of the Bureau being broad in its scope and the staff few in number, it is essential that the personnel be equipped as above outlined. At the present time four of the five positions are filled by school-of-mines men with practical experience in mines and smelters, added to technical training in the best professional schools, and the remaining position of geologist it is hoped will in the near future be similarly filled.

The Mining Bureau, as at present constituted and reorganized by Act 916, is essentially a Bureau to further the interests and development of the mineral resources of the Philippines in every practicable way, to advise the Civil Government concerning mining, metallurgy, the allied industries, and geology in its various practical applications, and to coöperate with other Government Bureaus to the fullest extent possible in the encouragement and development of the great latent natural wealth of the Philippine Islands. Incidentally, scientific work will be done by the various members of the Bureau staff in geologic, petrographic, and paleontologic research, but this will always be subordinate to the work in the various subdivisions of economic geology for which the Bureau has been reorganized, and will be contingent upon the time and facilities that can be utilized without injury to the work of more practical benefit and immediate need.

The functions of the Bureau represent, therefore, those of a State mining bureau in the United States rather more than those of the Federal Geological Survey, and it will be the chief aim of the Bureau to assist in the establishing and maintenance of a mineral industry in these Islands to the end that the mineral wealth may be brought into active yield.

In anticipation of the present organization the Mining Bureau has done work of the nature above outlined during the past three years, although, as originally established under the American occupation, by the order of the Military Governor, Gen. E. S. Otis, to First Lieut. Chas. H. Burritt, the most important work of the Bureau under the late able chief and lawyer was the review and report upon the status of Spanish mining claims and the study, translation, and interpretation of the Spanish mining law involved therein. The importance and magnitude of this work has never been overestimated, and it was a source of well-deserved satisfaction to Mr. Burritt, upon his elevation to the bench, to hand down to his successor, as Chief of the Mining Bureau, a completed work with respect to the Spanish law and claims. In addition to the above important service rendered, (1) of translating, editing, abstracting, and publishing the Spanish mining law complete, and (2) of reviewing and reporting upon mining claims pending against the United States by virtue of the treaty of Paris, the Bureau, under Mr. Burritt, indexed and classified all records received from the Spanish Inspección de Minas, studied the mining situation with reference to recommending legislation for the building up of an industry, advised the general public and the Government concerning mining rights, translated a large amount of material from the Spanish, published the Coal Measures of the Philippines, and Bulletins Nos. 1, 2, and 3, submitted ten volumes of special reports to the Military and Civil Governors and the Secretary of the Interior, initiated field work, and, upon the completion of the work for which the Bureau was originally reëstablished, and upon the increasing demand for a reorganized Bureau with present scope and purpose, advocated the passage of Act 915, "An act transferring the administration of mining grants and claims instituted prior to April eleventh, eighteen hundred and ninety-nine, from the Mining Bureau to the Bureau of Public Lands," and Act 916, "An act reorganizing the Mining Bureau and prescribing the functions thereof," the substance of which latter act is given above.

During the first four months of its establishment the Bureau consisted of its chief and the clerical force, and no provision existed for a technical or scientific branch. During July, 1900, however, authority was obtained from the Military Governor for the appointment of a mining engineer, and on August 1 the present Chief of the Bureau was selected for that position. This branch of the Bureau, technical and scientific, took charge of the departments of mineralogy, lithology, geology, assaying, field work, translation of technical papers, the extensive collections of the Bureau, the preparation of maps and plans for publications, the obtaining of information concerning the mineral resources, and the preparation in general for the future needs of the mineral industries; and it was this branch that by evolution and development became the reorganized Bureau of to-day. Reports were made by the mining engineer to the Chief of the Bureau upon various questions arising during the work, a large number of minerals, earths, coals, ores, and rocks were examined and reported upon for miners, prospectors, and others, Bulletin No. 1, Platinum and the Associated Rare Metals in Placer Formations, was prepared and published, as was also Bulletin No. 3, Report on a Geological Reconnoissance of the Iron Region of Angat, Bulacan; preliminary field work was done in Bulacan, Batangas, Culion, Busuanga, Cuyo, Paragua, and Balabac; a collection of ores, minerals, and rocks was prepared for the St. Louis Exposition, and collections of minerals, ores, rocks, catalogues, books, and other reference material were begun, for use not only in Bureau work but for the benefit also of miners, prospectors, and others to whom such material would not otherwise be available and whose needs the Bureau should constantly strive to serve.

It is planned, under the present reorganization, to prosecute field work as rapidly as possible in order that the mineral resources of the Islands may be reported upon without further delay; to take up statistical work in order that the records may be kept abreast of the infant but growing mineral industry; to prepare and publish reports and bulletins upon the subjects above as rapidly as opportunities permit; to increase the reference material of the Bureau, and to provide for the giving of information to visitors and correspondents in every practicable way; to do petrographic and paleontologic work; and in general to encourage and assist in the upbuilding of a profitable mineral industry, with every service of the Bureau free to all.

ASSAY WORK TRANSFERRED.

At the time of the original appointment of the mining engineer to this Bureau the Bureau of Government Laboratories had not yet been established, and there were few and very imperfect facilities in Manila for assay work. It was felt that some provision should be made for fire assaying and other ore valuation, and a limited supply of assay material was ordered from the United States. In the meantime such apparatus and material as were available for use from the property of the old Spanish Inspección de Minas were utilized so far as possible, as mentioned in previous reports, and some work of value was accomplished for the Bureau and for miners and prospectors in need of such aid. No fees whatever were authorized or charged. The limitations of available force, time, and material, necessarily kept this work within the preliminary stage, and no attempt was made to build up custom trade. Shortly after the arrival of fresh assay supplies the Bureau of Government Laboratories was organized, charged with all Government assay work, and authorized to collect fees for the custom trade. The other duties of the mining engineer precluding his giving more than a small portion of his time to assay work, and the law providing for the centralization of the Government Laboratories for purposes of economical administration, the mining engineer in his annual report for 1903 recommended that all assay supplies and apparatus, with the exception of blowpipe and other material required in the work of this Bureau, be transferred to the Bureau of Government Laboratories and thereafter all such work be performed therein. This transfer was authorized by resolution of the Philippine Commission, and on October 14, 1903, all such material was so transferred. Blowpipe and petrographic microscopical mineral and rock determinations will be done within the Mining Bureau by members of the Bureau staff especially selected and trained for the work, as such work pertains to this Bureau alone. All other laboratory work will be performed by the Bureau of Government Laboratories.

With the complete equipment of the new Laboratory building, probably the most thoroughly modern and extensive laboratory in the Orient, and with the reduced scale of assay charges recommended by this Bureau and favorably acted upon by the Superintendent of Government Laboratories and the honorable Secretary of the Interior, every need of miners, prospectors, mill men, and smelter men should be satisfactorily supplied, and there should be no further reason for sending samples for assay to the United States.

ADMINISTRATION OF MINING GRANTS TRANSFERRED.

In his annual report for the year 1903, Mr. Chas. H. Burritt, Chief of the Bureau, recommended "* * * that all remaining matters, relating to titles, be transferred to the Bureau of Public Lands, where the titles to mineral lands, under the new law, are now located by virtue of the act of Congress, thus leaving this Bureau for the geological and mineralogical studies just indicated and the systematic work of encouragement and promotion of the mining industry along the lines followed by the several State mining bureaus in the United States, but a work which is not accomplished or attempted by the Geological Survey of the United States."

The transfer of this purely land-office business was authorized and directed by Act 915 of the Philippine Commission, entitled "An act transferring the administration of mining grants and claims instituted prior to April eleventh, eighteen hundred and ninety-nine, from the Mining Bureau to the Bureau of Public Lands," providing:

> SECTION 1. The records and archives of all existing mining claims of whatever class or description now in the custody and under the charge and official control of the Mining Bureau and pertaining to the so-called Spanish mining grants and mining claims of every kind instituted prior to April eleventh, eighteen hundred and ninety-nine, shall be, as quickly as practicable, inventoried and turned over to the Bureau of Public Lands, and receipted for by the Chief of that Bureau.
>
> SEC. 2. The administration of such mining grants and mining claims of every

kind instituted prior to April eleventh, eighteen hundred and ninety-nine, and heretofore vested in and exercised by the Mining Bureau, is hereby transferred to and shall hereafter be vested in, and exercised by, the Bureau of Public Lands.

The above transfer was effected on October 23, 1903, and all land-office business pertaining to mining claims is now where it properly belongs—within the jurisdiction of the Bureau of Public Lands.

In this connection mention should be made of The Philippine Mining Code, compiled by Mr. D. W. Yancey, attorney, of the Bureau of Public Lands, containing a "Prospector's manual and codification of the mining laws of the Philippine Islands with forms; with which is published an appendix containing the acts of the Philippine Commission and extracts from the act of Congress of July 1, 1902, relating to mining." This little manual contains in concise form the information desired with reference to the law governing Philippine mining claims subsequent to the Philippine Act. It is published by the American Book and News Company, Manila, and it will be revised and brought up to date from time to time as subsequent legislation, rulings, and decisions may suggest.

This manual with Burritt's Abstract of the Mining Laws (Spanish Mining Codes) constitute the reference material of this nature desired.

QUARTERS OF THE MINING BUREAU.

The Mining Bureau is at present quartered in the four front rooms of the second floor of the old Casa Moneda at 358 Calle Cabildo, Intramuros. There is one side room adjoining these on Calle Recolletos, used as the office of the Chief of the Bureau, and there are several small rooms fronting on the courtyard utilized for storage purposes. The needs of the Bureau are such that the present accommodations are entirely inadequate. The offices in the Casa Moneda are cool and well ventilated, and the roofs and gutters having been recently repaired by the Bureau of Architecture, at the request of the Chief of this Bureau, the rooms are reasonably dry during the heaviest rains. The light is insufficient for the collections and for some of the desks, however, and the offices are crowded by the present force and will be still more cramped when the staff is complete.

It is not considered desirable to move the Bureau offices and property again until permanent quarters may be assigned. It is here recommended, however, as it was recommended in the annual report of the mining engineer for 1903, that "provision be made for a suitable wing of the new building of the Government Laboratories to be set aside and properly furnished and equipped" for the use of the Mining Bureau.

Plans have been submitted by this Bureau for the arrangement of rooms of the second floor of said wing, and it is believed that the accommodations suggested will satisfy the urgent need of more light and room, and will provide for a modern and permanent home, at present so greatly desired.

OFFICE WORK: EXECUTIVE, CORRESPONDENCE, EXCHANGES, LIBRARY OF CATALOGUES.

Notwithstanding the transfer of business pertaining to titles and mining grants and claims to the Bureau of Public Lands, the office work of this Bureau has steadily increased.

Reports, opinions, and advices have been given upon mining matters, and the mineral industries, and upon samples of ores, minerals, rocks, metals, and alloys sent to this Bureau for examination, these reports being either based upon analyses or determinations made by the Bureau of Government Laboratories by request of this Bureau, or, more often, upon blowpipe or other examination made within the Bureau by members of the Bureau staff. It has not been the policy of this Bureau to request work by the Laboratories that should properly be classed as custom work for which fees are charged, and all such work has been referred to the Laboratories direct. The geological, mineralogical, and metallurgical investigation and reports outlined above fall logically within the province of this Bureau, whose staff are especially trained and selected for the work and whose duties include the above as outlined in Act 916.

Correspondence with reference to the application of the mining laws to public lands has necessarily continued through the failure of many to understand that the jurisdiction of all such matters has been, since the passage of Act 916, within the province of the Bureau of Public Lands. All such correspondence has been referred by indorsement to the Chief of the Bureau of Public Lands and the writers interested have been so informed.

There has been a constant demand for information concerning the mining laws in force and requests have frequently been received for copies of the laws. To prevent the necessary loss of time involved in indorsement, reference, and correspondence, the Chief of this Bureau has obtained copies of the Philippine act and of the acts of the Philippine Commission Nos. 624, 777, 859, 1128, and 1134, constituting the complete mining legislation at present in force in these Islands, from the Executive Secretary, and has inclosed these copies within Manila covers with blue-print title, bearing upon the inner front cover notes to the effect that the Mining Code previously mentioned has been compiled by D. W. Yancey, and that "The inclosed acts of Congress and of the Philippine Commission, constituting the mining law of the Philippines complete up to May 20, 1904, are here gathered together merely for the convenience of correspondents of the Mining Bureau. It should be borne in mind that all questions of mining lands and mining law fall within the jurisdiction of the Bureau of Public Lands, to which Bureau letters upon matters not covered in the Mining Code should be addressed." These copies have been sent correspondents of this Bureau direct upon request and with blank receipt form inclosed.

Correspondence has increased in connection with mines and mineral resources, exchanges, the distribution of Bureau publications, the forming of a complete library of catalogues, executive and other work of the Chief of the Bureau, and replies to requests for information from America, Europe, and the Orient. The entire correspondence of the Bureau is now filed and indexed by the card system, and the economy thus obtained has been very marked. The labor and credit of transferring the correspondence of the Bureau for the past four years to files and indexing the letters under three headings each are due to Mr. Robert Clift Redmayne, chief clerk and stenographer. A great deal of overtime has been cheerfully and voluntarily performed by Mr. Redmayne in connection with this and other work, and the skill, good judgment, and zeal shown by him in this matter is but characteristic of him and his loyalty to his work. In this and in other office work Mr. Redmayne has had the faithful assistance of Mr. G. M. de Ubago, record clerk, who has occupied his present position in this Bureau for over four years, and whose services have been most valued throughout. The work of indexing the Spanish records, referred to in most complimentary terms by the late Chief of this Bureau and by the honorable Secretary of the Interior, in the report for 1903, was done by Mr. Ubago, and his ability shown therein deserves high praise.

During the year an important exchange system has been originated and developed and there are now on file in the reading room of the Bureau most valuable series of periodicals from America, Europe, and the Orient. These include engineering, mining, metallurgical, and geological publications, bulletins and reports of State and national mining bureaus and geological surveys, and papers devoted to subjects dealing with mining, metallurgy, and the allied arts. This valuable literature has largely been obtained through exchange with publications of the Bureau, but in a few cases paid subscriptions have been required.

The small working library of the Bureau has been but slightly increased during the year. There are a number of important and necessary references upon mining, metallurgy, geology, and the mineral industries, pertaining to the work of this Bureau alone and therefore of the greatest practicable benefit upon the shelves of the working library, which should be added without further delay. Authority has been obtained for the purchase of a complete set of the Transactions of the American Institute of Mining Engineers, a most invaluable series of papers covering the investigation of American mining engineers, metallurgists, and geologists for the past thirty-three years. A library of catalogues from several hundred firms in America and Europe manufacturing or dealing in mining, milling, and general supplies is being collected for the use of those who turn to this Bureau as a source of information upon subjects connected with the development of mines.

This library is being carefully gathered and indexed and should prove of great value to all requiring its use.

A double desk for the use of the public is maintained in the reading room, and furnished with necessary stationery for the taking of notes from books, periodicals, or catalogues. This desk is not used for any other purpose and is open to the benefit of the public at all times during office hours. The facilities of the Bureau for furnishing reference material for use at this desk, and for supplying information within the scope of the Bureau work, are constantly becoming more appreciated; and visitors are always cordially welcomed and assisted in every possible way.

MUSEUM WORK: ADDITIONS, EDUCATIONAL COLLECTIONS, CATALOGUING, PETROGRAPHIC, AND PALEONTOLOGIC WORK.

Valuable additions to the mineral museum and working collections have been made during the past year.

During the recent presence in the United States of the undersigned upon accrued leave he was authorized to purchase specimens for the working collections of the Bureau not to exceed in cost $650, United States currency. The sources of supply in New York, Philadelphia, and Washington were visited, and contracts were finally made with Geo. L. English, to furnish one general collection of 350 pieces, representing the more important minerals, especially those entering into the composition of rocks, and one representative collection of 200 pieces exhibiting the ores and minerals of economic interest. A contract was also made with Edwin E. Howell, of Washington, to furnish a working collection of 225 specimens of rocks, and another collection for comparative purposes of 250 specimens of fossils, particularly those of the Tertiary and Quaternary, for use in stratigraphic and paleontologic work. These collections were satisfactorily packed and turned over to the New York office of the Insular Purchasing Agent for shipment to Manila. They have since been received in excellent condition and installed in cases in the Bureau. These collections, while handsome and making a most attractive display, have been purchased as working collections, and are as necessary as books in the comparative and determinative work of the Bureau. They are also of great value to visitors, particularly to miners and prospectors, and in educational use alone are worth their cost.

The field work of the Bureau has resulted also in additions to the collections, particularly of ores and rocks. The field party under Mr. A. J. Eveland, geologist, working in Lepanto, brought back a suite of nearly 100 specimens of copper and gold ores and smelter products, gangue minerals, country rock, and models of primitive Igorrote metallurgical apparatus and tools. The exploratory march across the Island of Mindoro, by an expedition of the Twelfth Cavalry, in which the Chief of this Bureau took part, resulted in a suite of 20 specimens collected at intervals across the island, showing slates, white marbles, and precious serpentines, never before known in Mindoro. A brief trip made by the Chief of the Bureau to the Taal Volcano also resulted in a small collection of volcanic rocks later to be worked up. In addition to the above a large number of samples of ores, coals, clays, rocks, guanos, and a few fossils have been contributed by miners, prospectors, and other friends of the Bureau, to whom the obligation of this acknowledgment of appreciation is due. Among these should be especially mentioned a collection of 28 samples of gold, iron, and manganese ores of the mineral region of Arroroy, Masbate, kindly given by Mr. Heise, whose interests are extensive in the region named.

In order better to facilitate the exhibit of the mineral resources of the Philippines the museum has recently been entirely rearranged, and the economic collections are now given the most conspicuous display. One case is devoted entirely to coals, another to gold ores, a third to copper, lead, and iron ores, and a fourth to pottery and brick clays, cement and limestone, and building stones, all from the Philippines. In addition to these a handsome hexagonal cabinet at the head of the stairway contains the economic collection purchased in the United States, and another case contains copper tools, showing the methods of Igorrote copper metallurgy in Lepanto, and iron castings, molds, and apparatus illustrating the Tagalog iron smelting in Bulacan.

Two large cases are filled with the general collection of minerals recently acquired.

One large case contains the fossil and the rock collections purchased in the United States, and in a number of other cases will be arranged by provinces, for geological work, the various mineral and rock specimens, not previously included, from the different areas of the Philippines.

The greater part of the museum has been recatalogued since the establishment of the Bureau, but it is now the plan of the Chief of the Bureau to systematically recatalogue the collections entire by the card system, to the end that the greatest possible efficiency of their service may be obtained.

Great credit is due Mr. H. M. Ickis, field assistant, for his rearrangement of the collections, and for his enthusiasm and intelligence in the museum work of which he has been placed in charge.

The ordinary macroscopic and blowpipe determination of minerals and rocks has been carried on in the Bureau for the past four years. These determinations are in most cases readily made and require the skill and training of the mineralogist and petrographic geologist rather than those of the chemist. They are, therefore, as they have been, proper subdivisions of the work of this Bureau. The microscopic determination of minerals and rocks, requiring the work of a petrographer and geologist, will also be done in this Bureau, as will the paleontologic work in the study of fossils for stratigraphic and correlation work in connection with the investigations of the coal, iron, limestone, and clay series of the Philippines. The work of the Bureau is so planned that these subdivisions of purely mineralogic and geologic work will be allotted to members of the Bureau staff especially assigned to the investigations, and all, with the exception of one geologist, now appointed and at work. The investigations, both in office and field, are following, as fast as appropriations and resources permit, along systematic lines planned by the present Chief of the Bureau years in advance of the work.

FIELD WORK.

Although the provisions of Act 916 reorganizing the Mining Bureau were effective on October 15, 1903, and the present Chief of the Bureau began the reorganization authorized on November 2, the first field assistant, Mr. H. M. Ickis, was not secured until November 17, 1903, and the first geologist, Mr. A. J. Eveland, did not arrive from the United States until January 16, 1904. Field work for the fair season in Lepanto and Benguet had been planned in advance, but no funds were available for the first half of the fiscal year and the party could not be equipped and started north until after the passage of Appropriation Act 1049, on February 11, 1904. Upon the funds appropriated therein becoming available, the party was promptly organized, equipped, and placed in the field with complete instructions for their guidance in the prosecution of their work.

This party, consisting of Mr. A. J. Eveland, geologist in charge; Mr. H. M. Ickis, field assistant, and Mr. Levi Riendeau and Mr. Robert Grant, temporary employees, left Manila on the Coast Guard steamer *Masbate* on February 23 and disembarked at Candon on February 26. After various delays, chiefly from difficulty in securing transportation, the party reached the copper district of Mancayan on March 10 and systematic work in compliance with instructions was begun. From Mancayan the party moved to Suyoc for the completion of the work in that part of the field, and on June 22, the rains having brought further work to an end, and the reconnoissance being, in the opinion of Mr. Eveland, fairly complete, the return to Manila was begun. Mr. Goodman, field assistant, who joined the party March 13 in Lepanto, was instructed by telegram to relieve Mr. Eveland and bring the party to Manila, making a route survey from Cervantes to the coast. Mr. Eveland was relieved of charge by the same telegram and instructed to return to Manila through Benguet in order that conditions might be observed there with reference to future work. Mr. Goodman, with the assistance of Mr. Ickis and Mr. Riendeau, was singularly successful in the completion of a difficult route survey, and to him and his associates great credit is due. Later, when awaiting transportation at San Fernando, Mr. Goodman was "authorized" by telegram to make a route survey from the coast to Baguio, thus giving surveys of two important transportation routes from the coast to the respective capitals of the northern mineral provinces. Although only "authorized," because the Chief of the Bureau could not be satisfied that sufficient time was available before the arrival of the next transportation to bring the party south, Mr. Goodman showed his commendable spirit by beginning the survey immediately and completing it within four days at Baguio, where he reported by telegram. He was there taken with a high fever and went to the sanitarium. Mr. Ickis, in answer to a telegram for instructions, was directed to bring the party to Manila, which he successfully did after various vicissitudes due to lack of transportation. Mr. Eveland returned over the Benguet Road to Dagupan and from there to Manila by Coast Guard steamer *Basilan*, Mr. Goodman following him a few days later by the same route.

The party were absent from Manila over five months, although two months of this time were devoted to the delays necessary for transportation to and from the areas surveyed. A narrative report from Mr. A. J. Eveland, geologist, in charge of the party up to the completion of the work at Mancayan, has been prepared by direction of the Chief of the Bureau and is herewith respectfully submitted as Exhibit B. This report, and the successful completion of the work involved in the reconnoissance executed by Mr. Eveland, speak for themselves and are a credit to Mr. Eveland in his first work in difficult Philippine fields.

A more complete report giving the important results of Mr. Eveland's investigations in the field, with maps from the surveys of Messrs. Goodman and Ickis, megascopic and microscopic determinations from this Bureau, and assays and analyses from the Bureau of Government Laboratories, is now in course of preparation and it is hoped will soon be published as a bulletin from this Bureau.

A map is herewith respectfully submitted showing the area covered by topographic survey and geological reconnoissance in Lepanto Province, the route surveys made, and the routes of travel followed by the party as a whole or as later divided in going to and from the area surveyed.

In addition to the field work outlined above, an examination was made by Messrs. Eveland and Ickis, by direction of the Chief of the Bureau, of certain gold placer deposits at the junction of the San Mateo-Novaliches Road and the Novaliches River, in connection with the identification of placer platinum, evidences of which metal were suspected by this Bureau from examinations of gravel brought in to the office. As a result of this work, and the final confirmation from the Bureau of Government Laboratories from samples submitted by this Bureau for analysis, the Chief of the Bureau is now justified in announcing the definite discovery of platinum in the Philippines. The amounts found are not yet of commercial importance, but it is hoped that more favorable reports may be made by this Bureau as a result of more extended work.

In Rizal Province, also, the Chief of the Bureau found time to examine some reported coal deposits in the mountains east of San Mateo. The seams observed were found not to be of sufficient thickness for profitable exploitation, and by analysis the coal was found to be 35 per cent ash. Although these seams are unimportant it has been known for some years that a good lignite occurs in apparently large amount nearer the towns of Bosoboso and Antipolo, Rizal.

During the month of April of the present year the Chief of this Bureau, by invitation of Maj. W. W. Gibson and Capt. R. E. L. Michie, U. S. A., of the general staff corps, and of the military information division, headquarters of the Philippine Division, and through the courtesy of the officers of the party, was a member of an exploring expedition fitted out from the Twelfth Cavalry at Camp McGrath, Batangas, for the purposes of crossing Mindoro from Baco on the east coast to Santa Cruz on the west coast and of seeking such information as was to be obtained concerning the people, resources, and conditions of the interior of this portion of Mindoro, hitherto not known to have been explored.

The expedition, consisting of First Lieut. Fitzhugh Lee, jr., Twelfth Cavalry, in command; First Lieut. John W. Hanner, Medical Department, medical officer; Second Lieut. Robt. McC. Beck, jr., and Chas. R. Mayo, Twelfth Cavalry, intelligence officers, and the Chief of this Bureau, with 14 picked troopers from the Twelfth Cavalry, 2 Hospital Corps men, and 32 cargadores, was organized, equipped, and supplied at Camp McGrath, Batangas, by direction of Lieut. Col. Geo. F. Chase, Twelfth Cavalry, commanding the regiment and post, and left Batangas on April 2, on the Army Q. M. D. launch *Atlanta*, arriving and disembarking at Baco, Mindoro, on the same afternoon. The Baco River was ascended in bancas for about 12 miles, and at the point of debarkation the march began. The right bank of the river was followed until the north arm, called the Alog, was reached, and this in turn was followed until a series of gorges and precipices accompanied by waterfalls made farther progress impossible. The north arm of the Alog was then followed to its head waters, beyond which the mountain divide, here a north spur of Mount Halcon, was crossed at an altitude of 3,200 feet. The head waters of the Bagbajan River appearing on the west slope, the expedition followed this river from source to mouth at the barrio of Bagbajan on the west coast. A half day's march down the coast brought the party to the barrio of Santa Cruz, on April 19, where the launch *Atlanta* arrived a few days later with additional supplies. The return to Batangas was made around the north coast of Mindoro by this launch.

The party crossed Mindoro on foot, in light marching order, and carrying all supplies upon the backs of native cargadores. They slept at night on the ground under 8-ounce shelter halves, and subsisted upon the excellent military rations of hard bread, bacon, canned stew, and coffee, the natives being furnished canned salmon and rice. The trip proved to be one of exceptional difficulty as judged by the previous field experiences of the members of the expedition. There were no roads and only in few portions of the route were there signs of Mangyan trails. There were no sources of supply, the only inhabitants of the country being the wild Mangyans. The rain fell in torrents during the seven or eight days in the forests of the divide and during the darkness of the night of April 12 the party barely escaped losing their supplies, if not their lives, from a mountain flood which swept down the narrow valley carrying everything before it.

The interior of Mindoro traversed by this expedition was found to contain no settled or civilized inhabitants, the only natives met being the wild Mangyans. The forest contains many fine woods, the brea blanca, and what appeared to be gutta-percha, and nutmeg, and, on the higher western slopes, true pine trees; and the rock exposures showed great thicknesses of crystalline limestone, much of it a fine white marble, and of slates. Precious serpentine was found as float, as was bornite, a valuable copper ore. The streams were panned for placer gold, platinum, and tin, but none were found. The rocks in general are metamorphic and apparently of considerable age. The volcanic rocks were found only on the west coast. The upper valley of the Bagbajan is in beautiful open country, suggestive of farming and grazing possibilities. The soil seemed rich wherever examined. Wild game, both large and small, occurs in abundance, but the size of the party and the rapid marches necessary to traverse the island before the supplies were exhausted prevented much satisfactory hunting, as this rapid progress precluded also detailed examinations of exposures where found.

Route surveys were made from coast to coast by Lieutenants Beck and Mayo, and the Chief of this Bureau is only awaiting copies of the maps resulting from these to complete his report upon this trip.

The success of this expedition, traversing a portion of Mindoro which, it is understood, previous expeditions had failed to cover, was due, in the opinion of the Chief of the Bureau, to the able leadership of the officer in command, Lieut. Fitzhugh Lee, jr., supported by the loyal assistance of Lieutenants Hanner, Beck, and Mayo, the good spirit and splendid service under most difficult conditions of the enlisted men of the command, and the uncomplaining, dogged perseverance of the native cargadores employed.

Advantage was taken by the Chief of this Bureau of the half holiday of July 2 and of the holidays of July 3 and 4, to make a preliminary visit to the Taal Volcano, in Batangas Province, then in unusual activity, for the purpose of collecting material for study and of outlining plans for some future work. It is hoped, as opportunities and time from more pressing work permit, to edit, bring up to date, and publish, as bulletins of this Bureau, reports and papers written by former Spanish geologists of the Inspección de Minas, upon volcanoes of the Philippines, translations of which have already been made by the undersigned. A careful study of volcanic phenomena should throw much light upon geologic conditions of the past.

The future fieldwork of the Mining Bureau has been planned by the Chief of the Bureau for several years in advance, and this work will be carried on as fast as opportunities, the field force, and funds appropriated permit.

With appropriations at present available it is planned in the immediate future (1) to investigate the mineral resources of Benguet, and Mr. A. J. Eveland, geologist, will probably be detailed for the work; (2) to examine the coal deposits of Batan and the gold gravel deposits of Masbate, and the Chief of the Bureau will attempt sufficient time in connection with his other work for this and other field trips of comparatively short duration of time from the office; (3) to continue the collection of statistics and general information concerning the mineral resources and industry, to which work Mr. Maurice Goodman, field assistant, has been provisionally assigned; (4) to continue the gathering of information concerning brick and pottery clays, limes, cements, and building stones, the beginning of which has been made by Mr. H. M. Ickis, field assistant; (5) upon the appointment, in immediate prospect, of the other geologist authorized, to systematically examine the stratified economic deposits of the Islands with particular reference to the development of deposits of iron and coal.

In practically all geological and other survey fieldwork in the Philippines difficulties must be overcome due to the heavy vegetation, insect pests, heat, rain, lack of satisfactory maps, transportation, labor, and frequently of supplies, and to the menace, from constant exposure, to continued health and strength. That these difficulties have been overcome by United States troops and by prospectors in the past has been mentioned in previous reports of the undersigned, and that they are being surmounted now is continually being demonstrated by field parties from the Army and Constabulary and from various Bureaus of the Government, particularly of the Department of the Interior, operating and exploring in the remotest and most inaccessible portions of the Archipelago.

The result of this work, largely untouched until within the past few years, is that the people, natural resources, and conditions of the Islands are becoming better known, and knowledge obtained concerning them is being published in form accessible to the Government and general public alike.

The time must inevitably come when the pioneer work, begun so many years ago, of exploring and developing these Islands will have been complete: it is a privilege to be here now and to contribute in some small degree to this end.

PRESENT STATUS OF MINING.

Mining development is at present being carried on in Lepanto-Bontoc, Benguet, Bulacan, Rizal, Tayabas, the Camarines, Albay, Masbate, Cebu, and Mindanao.

In Lepanto, according to the report of Mr. Eveland, geologist, assessment work on gold and copper claims has been done to considerable extent, although much work at Mancayan has been prospecting only in the softer rock. Some earnest development work has been done, however, particularly at Suyoc, and at the present time it is understood that further serious development is going ahead at Mancayan upon a larger scale than before since the American occupation. Although timbering in some of the Lepanto workings is reported insufficient, that in others of them has been done in a thorough workmanlike manner. The miners of Lepanto have in general been working against many obstacles, not the least of which has been difficulty of transportation and supply, and a scarcity of funds. They deserve credit on the whole for what they have been able to do.

In Benguet much more important work has been done. On one lead at Antimok Mr. Kelly has persistently developed his property, a promising gold lead, and has now gone to the United States, it is understood, for the purpose of purchasing a stamp mill complete. A little farther south Messrs. Petersen and Clyde are developing their claims in a businesslike way and are contemplating a stamp mill with dam, flume, and a turbine power plant. Farther south some unfortunate litigation has suspended work. The Philippine Gold Mining, Power and Development Company, of which Dr. J. F. Kemp is president and Mr. H. J. Robinson is manager, are developing five gold claims about 4 miles from Kias, and have recently purchased, imported, and shipped to their mines a ten-stamp Hendy mill, with a Woodbury concentrator, a Blake crusher, a Pelton water wheel capable of operating sixty stamps, and an assay equipment complete. For some time past Mr. Hartwell has been operating at a profit, it is understood, a three-stamp mill built by himself in the Manila shops. This is the pioneer mill whose stamps have fallen during American occupation, and Mr. Hartwell deserves great credit for his energy, industry, and mechanical skill. Other gold properties are being earnestly developed in Benguet, a number of them promising success, and it is hoped that detailed information concerning them may be available at an early date. Copper has also been discovered in Benguet and a number of copper claims have been located, recorded, and worked. The greater number of the copper ores of Lepanto and Benguet carry gold.

In Bulacan the iron deposits of San Miguel de Mayumo and Angat have been yielding sufficient ore for almost continuous smelting on a small scale for the casting of plowshares and points. Litigation, unfortunately, that should be brought to an early and definite conclusion, is still afflicting this small but prosperous industry at Angat. As shown in Bulletin No. 3 of this Bureau, upon "A Geological Reconnoissance of the Iron Region of Angat," much of this ore is exceedingly rich and pure and the deposits are believed to be extensive indeed. The Chief of this Bureau greatly regrets that up to the present he has been unable to interest the iron works and foundries of Manila in the investigation of these valuable iron deposits so near at hand. It seems quite feasible to ship these ores to Japan, where the demand, it is understood, is great and the supply almost entirely of foreign origin. This matter, rendered more hopeful by the extension of the Manila and Dagupan Railway through the town of San Miguel, will be taken up with exporting companies at an early date.

In Rizal some prospecting has been done for coal and gold and natural cement rock, and a number of gold placer claims have been located and worked to the north and west of the towns of Montalbon and San Mateo. In some of these claims platinum occurs in small amounts, as previously stated in this report.

In Tayabas a number of claims have been recorded during the past year, including twenty-two petroleum locations. Details from these fields have not yet been obtained.

In the Camarines Province, notwithstanding the valuable concessions granted by the Crown of Spain in the gold districts of Paracale and Mambulao, practically no work, beyond the original restaking required by law, has been performed upon these claims. Extension of time for the legal performance of labor required by the Spanish laws under which concessions were granted has been generously granted by the honorable Civil Governor upon requests by the British and German syndicates, favorably indorsed by this Bureau, but owing to difficulties due chiefly in securing capital in Europe and the United States, it is understood, this time is rapidly drawing to a close and the cancellation of the valuable concessions, upon which much money was expended during Spanish days, seems the inevitable end. This is greatly to be regretted, but it is hoped that future companies may develop the gold deposits of Mambulao and Paracale to the extent they seem to deserve. Much prospecting has been done in the Camarines during the past four years and a number of locations have been made in the above districts under the present laws. Placer and dredger mining, which has been so profitable here in the past, is reported as still capable of yielding important returns.

In Albay Province coal mining has been carried on, particularly in the Island of Batan on the east coast.

The Gil Brothers are reported to be developing a coal mine on the

Island of Batan in five seams, each 1 meter thick, of good black lignite, with a force of Spanish and Japanese miners, and the report of the Japanese engineer who examined the "Bilbao" mine, upon which work is now being done, estimated that when fully opened up this mine should be able to produce 1,000 tons of coal per day. These expectations are yet unfulfilled.

In Batan Island, also, on the southwestern peninsula reserved for military purposes, Lieut. H. L. Wigmore, Corps of Engineers, United States Army, assisted by a detail of men, is prosecuting a thorough examination of the coal deposits by means of the diamond drill. The coal there is of excellent reputation and suitable for steamer use.

In Masbate much prospecting, assessment, and development work has been done, particularly at Arroroy on the north coast. Three companies have been working there, and one of them has recently had completed in San Francisco and prepared for shipment a modern dredging plant complete. This company has also ordered a stamp mill for crushing its free-milling ores. The prospects here seem bright.

In Cebu some prospecting and locating has been done upon coal deposits, but, so far as known, no real development has yet been accomplished since Spanish days. Within the last few months, however, much interest has been shown in the extensive and valuable coal deposits of Cebu, and in the near future some activity in mining should be displayed.

In Mindanao, with the exception of the gold fields of Placer and Surigao, where a handful of earnest miners have been working for the past two years, the status is largely that of prospecting. New deposits are being looked for and the island is being gradually but extensively explored.

Through the courtesy of the Chief of the Bureau of Public Lands the following information was obtained showing new locations during the fiscal year 1904:

Ambos Camarines, 10 lode claims (gold).
Batangas, 12 lode claims (not specified).
Benguet, 43 lode and 8 placer claims (gold).
Bulacan, 2 placer claims (gold).
Capiz, 1 placer claim (gold).
Cebu, 1 placer claim (coal).
Laguna, 4 placer claims (not specified).
Lepanto-Bontoc, 36 lode claims (not specified).
Masbate, 25 lode and 25 placer claims (not specified).
Mindoro, 1 placer claim (gold), and 2 claims (1 guano, 1 stone).
Misamis, 8 lode claims (gold.)
Pangasinan, 36 lode claims (30 gold, 6 copper).
Rizal, 25 claims (11 gold, 1 copper, 2 coal, 5 guano, 3 stone, 3 iron).
Surigao, 18 lode claims (gold).
Tayabas, 45 placer and 12 lode claims (1 silver, 4 copper, 22 petroleum, 4 coal, 19 guano, 4 stone, 3 lead).
Zambales, 3 lode claims (not specified).

From the foregoing it will be seen that there have been reported as located during the fiscal year 1904 ending June 30:

Lode claims	209
Placer claims	109
Total	318

Of these the following are represented:

Gold claims	132
Silver claims	1
Copper claims	11
Petroleum claims	22
Coal claims	8
Guano claims	23
Stone claims	8
Iron claims	3
Lead claims	3
Not specified	107
Total	318

The above shows a steady increase in prospecting, locating, and recording claims.

In addition to mining work proper the allied mineral industries are yearly becoming of greater value and importance. Brick and pottery are being made by natives in a large number of provinces, limestone is burned for lime and it is hoped will soon be used for cement, and rock for building and other purposes is quarried and sold.

The quarries on the Island of Talim, Laguna de Bay, furnishing rock for the streets of Manila, and of Mariveles, furnishing rock for the works of the port, have been particularly active during the past year. The rock from the former is apparently a dark basalt, and that from the latter a gray andesite, in part with augite in important amount. Through the courtesy of Mr. L. F. Patstone, superintendent of street construction and bridges, whose efficient engineering skill and ability is everywhere evident upon the improved streets of Manila, the following information is abstracted from his annual report: The rock for Manila is quarried at the Island of Talim, Laguna de Bay, crushed at the plant there equipped with one 125-horsepower engine and three crushers with a combined capacity of 63 tons per hour, and brought to Manila in cascoes, a distance of 27 miles. The force at Talim consists of a foreman at $100 per month, and 1 quarryman, 1 engineer, 1 assistant engineer, 1 capitan, and 95 laborers, at ₱7, ₱3.50, ₱2.50, ₱3.50, and ₱1, per day, respectively. The amount of rock crushed during the year was 33,045 cubic meters, at a total cost, for labor, coal, dynamite, powder, oil, and waste, of $3,010.17, the crushed rock being delivered at the Bridge of Spain, Manila, at a cost of $1.18 per cubic meter. These figures show extensive work and are complimentary to those in charge.

Through the courtesy of the superintendent of the Atlantic, Gulf and Pacific Company, the following information has been obtained concerning the rock quarries at Mariveles, Manila Bay: The number of natives employed at the quarries is about 1,000, directed by a force of from 30 to 40 white men. There are excellent facilities for handling the rock and loading it upon barges for transportation across the bay. The company is using 18 derricks with dummy engines and cable complete. The amount of rock quarried to date is about 603,000 tons, and the amount quarried at present is at the rate of 20,000 tons per month. The native labor is paid, on the average, ₱1.10 per day, and under proper supervision has been very satisfactory. The labor problem, in the opinion of the Chief of this Bureau, has been solved to the lasting credit of the officials and foremen of this company. The natives are content, enjoying complete community life with houses, schools, and churches erected by the company, and they give a fair day's work for the wages paid. They are satisfied and the company, as a matter of fact, faces no "labor problem" at all.

In addition to the above industries earths are dug from clay banks in many provinces for use in whitewashing and other wall decoration; and a mineral paint factory in Santa Ana is doing an excellent business in paints made exclusively from Philippine earths. Plans are now on foot for a reorganization of this business with largely increased capital for the extension of its trade.

Mining labor has not yet been developed as such to any great extent in the Philippines. The Manila Street Railway Company, the City Engineer and his corps of engineer superintendents, the Atlantic, Gulf and Pacific Company, and the Bureau of Improvements of Benguet, all employing large numbers of native laborers, have demonstrated a theorem suggested by this Bureau two years ago: The success achieved is largely a matter of competent supervision exercised by the best foremen to be obtained. The Tagalogs, Igorrotes, and Bicols are reported to be fairly good quarrymen and outside men, and with able white foremen should be able to furnish the bulk of the labor required. True, natives can not perform the amount of work of an equal number of white men in the mines, but this need not prevent their use. The great gold mines of India and of the Rand are worked with native labor—and among these are thirteen of the first twenty gold mines in the world. It should be borne in mind that there is no large class of natives in these Islands as yet that has been tried in mines, and it should be remembered that failure to succeed outside need not necessarily condemn labor underground. Conditions in mines are pretty much the same the world over, and labor that may be lazy, shiftless, and unsatisfactory under the tropic sun may prove excellent in the cooler air of the mines. A Spanish mining superintendent is authority for the statement that he could secure sixty-five good Visayan miners in the city of Cebu to-day and begin the development of any coal mine in that island; that with these men instructing raw material he could in time develop any reasonable number of miners required. He stated also that in mine timbering and other precautions of safety the Visayan was as good a miner as could be desired. Why should these commendations apply to the Visayan alone? It is suggested that, however unsatisfactory native labor may be now, a mining class can be developed under proper guidance and within a reasonable time. There seems to be nothing to prevent the importations of Japanese miners, as the Mining Bureau, having shown to the Collector of Customs that a miner is a skilled laborer, the Collector has rendered a decision to the effect that miners, other than Chinese, may be imported under the law. It is believed that a supply of mine labor can be developed under competent American or European foremen, or imported under the law, sufficient to work the mines of the Philippines.

The transportation problem is being rapidly solved. Vast sums of money are being expended annually by the insular and provincial governments in the all-important construction of bridges and roads; trails are being opened up and improved, railroad extension has already begun, and more is promised, with every indication of success. Conditions so discouraging a few years ago are improving so rapidly that it is not thought serious difficulty in transportation will much longer present itself.

Unsettled conditions due to brigandage and insurrection are no longer such as to delay the development of mines for twenty-four hours. The armed and organized insurrection against the United States has been effectually, and it is believed forever, suppressed; and the sporadic ladronism existing among wandering malcontents and carabao thieves, far from preventing the development of mines, is not of sufficient importance to prevent prospectors or miners from working in any mining district in the Philippines.

It must be admitted that the present mining legislation, comprised within act of July 1 of the Congress of the United States and 624, 777, 859, 1128, and 1134 of the Philippine Commission, is far superior to the complex Spanish law, in that (1) it leads to the granting of absolute title instead of a more concession; (2) its processes are simple and its language concise; and (3) it encourages bona fide mining and tends to establish confidence in mines located and worked under the restrictions it provides. It is superior to the United States mining laws in that the uncertainties, litigation, and loss resulting from the so-called "apex system," granting extralateral rights, which has been fought by the ablest writers upon mining law in the United States for twenty years, and which obtains in the western mining States only as a result of purely local conditions, has been entirely omitted in the framing of mining legislation for the Philippines; and all mines owned and worked in these Islands under the present law may at least be free from the feature that has proved most expensive and disastrous in litigation connected with mines in the United States.

On the other hand, section 33 of Act 235 provides: "That no holder shall be entitled to hold in his, its, or their own name, or in the name of any other person, corporation, or association, more than one mineral claim upon the same vein or lode." This most unfortunate section will naturally operate against the development of any but the richest lodes, and in the Philippines, as in mining districts the world over, the bonanzas are few and the deposits of low-grade ores relatively large. In Lepanto and Benguet, as well as in the Camarines, Masbate, and Mindanao, there are important deposits that should be worked on a large scale and which, under section 33, can never be worked at all. It is safe to say that under section 33 neither the famous Homestake nor the Alaska Treadwell mines would ever have been developed; and yet these are among the greatest gold producers known. The ore of the Homestake mines in South Dakota averages only $4, and that of the Alaska Treadwell only $2, to the ton; yet these mines, being able to handle immense bodies of ore, are among the best paying and soundest mines in the world. The former requires 900 stamps, yielding a monthly output of $375,000 of gold, and the latter employs 540 stamp, paying $130,000 a month.

The low-grade ore deposits in the Philippines are so extensive and valuable that section 33 tends to operate as an obstacle tò the development of the greater part of our metalliferous resources. The Chief of the Mining Bureau, the Secretary of the Interior, and the Civil Governor have repeatedly advocated and urged the repeal of this unfortunate restriction in the act of July 1; and the sentiment of those interested in mining in the Philippines is safely unanimous in favor of such repeal. It is sincerely tó be hoped that favorable action by Congress upon this important matter will not longer be delayed.

The development of the natural resources of the Philippines means the development of the Filipinos themselves. It would seem to the best interests of the natives, as well as of the Islands at large, to bring every natural resource into a high state of development and active yield. This implies the need of capital, and without sufficient security in number of claims for development capital will interest itself in more promising fields than are presented here. Without development the greatest danger seems to be that the resources will remain idle rather than be exploited, and this at the real expense of the natives themselves.

THE MINERAL RESOURCES.

Presented herewith is a map of the Philippines, prepared in this Bureau, showing the locations of the known and reliably reported mineral deposits of economic value. The map itself is based upon the latest Army Signal Corps map of the Philippines, the lines being omitted and the geological data being here introduced. A similar map upon a larger scale, equally self-explanatory, forms an exhibit of this Bureau at the St. Louis Exposition. The artistic handiwork upon both of these maps is the work of Hugo Navarro, assisted by Justo Reynoso, draftsmen of this Bureau. To them just credit is due.

From interviews with prospectors, miners, and mining engineers who have visited the mining districts, from authorities translated and studied, from the assay returns of the Bureau of Government Laboratories, and from the fieldwork of this Bureau, the following general and popular account of the mineral resources has been prepared. A more complete paper is held for data now being obtained.

GOLD.

This metal has been found in almost every island of importance of the group. It has been worked by natives in placers and in stringers from time immemorial and the total production of the Islands must have been considerable indeed, although no reliable statistics have ever been kept. The manager of one of the local banks is authority for the statement that at one time a great deal of nugget and other alluvial gold was received at the bank. Mr. Richard von Drasche, a German geologist who has done some field work in the Islands and has published important papers upon Philippine geology, states that at the time of his visit to Mambulao and Paracale (Camarines Province) there were over 700 natives working the placer deposits for gold. It was estimated by a Spanish governor of Manila of the seventeenth century that the annual output of gold from Camarines Norte was about $200,000. This seems well within possibility and is an indication of what was yielded to native methods. The natives in no part of the Islands have been able to dredge or sluice, nor have they penetrated more than 50 or 100 feet into the rock at any place. Abella states, in his "Ligera Reseña de la Minera de las Islas Filipinas," that from 3,000 to 4,000 pesos worth of gold was taken annually from the streams in the mountains of Bulacan near Santa Maria de Pandi. This statement has not appeared elsewhere to the knowledge of this Bureau and it is not known upon what information it is based. It is believed, however, that a great deal of placer gold has been obtained in the past by natives of Bulacan. It has been estimated by Centeno (1876) that the placer output of the Misamis and Pigtao fields in northern Mindanao has been, in the hands of the natives, about $27,000 per annum; and Mr. William Asburner, an American mining engineer, states that he was informed that $20,000 worth of gold had been taken by natives from the placer fields of Surigao, in northern Mindanao, in 1882. No figures are yet available from Benguet or Lepanto, but a prominent mining engineer recently stated that during his visit last year in Benguet two American miners obtained 20 pounds of gold from rich stringers in seven days. It is known that some of these stringers worked by the natives have been enormously rich. The greater number of the richer placers readily accessible to man have probably been pretty thoroughly worked over from the surface, but it is known that the natives, and Spaniards also, have seldom gone to bed rock.

From the Pigholugan region, in northern Mindanao, Mr. J. Clayton Nichols, an American mining engineer, states that he was informed that $4,000 was taken from one hole and $2,500 from another.

In the northern part of Masbate, near Arroroy, three American mining companies have recently staked out and recorded a large number of placer and lode claims, and work is going on upon these at the present time. It is understood that an American consulting engineer who has recently visited and reported upon this field was most favorably impressed with the outlook for mining the alluvial gold in that region. A number of placer claims have also recently been staked and recorded by Americans in the head waters of the San Mateo River, in Rizal.

In the Pigtao region of northern Mindanao Mr. Nichols estimates the value of the gravels to be from 15 to 25 cents to the cubic yard in such quantity as to suggest the careful study of that field with respect to the use of the steam dredge.

In addition to the districts mentioned above, gold has been worked to a greater or less extent by the natives in Fidelisan, Bontoc Province; Suyoc, Dugon, and Tuboc, Lepanto Province; Acupan, Tabio, Capunga, and Itogas, Benguet Province; Capan and Peñaranda, Nueva Ecija Province; the Islands of Polillo and Catanduanes, Labo, Capalongan, and Maculabo, in the Camarines; Atimonan, in Tayabas; and in Cebu, Panay, Samar, and Panaon.

The gold from Benguet, Lepanto, Surigao, and Misamis has been found largely in small seams or stringers in quartz, although true veins have been found in all of these districts save the last. The most promising veins from Mambulao and Paracale are reported to be contact veins between gneiss and diorite. The best-defined veins appear to be entirely in the older crystalline rocks; those of the Camarines and Masbate notably so. Assay values of many veins sampled throughout the Islands by prospectors and miners vary between a few cents to several hundred dollars to the ton. As it is not known by what method the samples were taken, a table of assay returns is not presented here. Suffice it to state that from present knowledge there are well-defined veins of sufficient width and assay value so far sampled in Lepanto, Benguet, the Camarines, and Masbate to justify extensive development work, and that such work is now in prospect or performance upon claims in these districts.

The above notes apply to placer or free-milling gold. There are vast deposits of low-grade, free-milling, and partially or wholly refractory ores in Lepanto and Benguet that have not yet received the investigation they deserve. Miners and prospectors have devoted their energies during the past four years entirely to the most promising fields so far found.

It is believed, from present information, that there is a future for hydraulic and dredger alluvial mining in the Camarines, in Masbate, and in Mindanao, and for vein mining in Lepanto, Benguet, the Camarines, Masbate, and Mindanao. Later and more detailed information must necessarily depend upon development work now in progress, and it is hoped that future work will extend rather than diminish the list given above.

The majority of Philippine gold ores now being worked are crushing and amalgamating ores, a few must be smelted, and cyanide plants will probably be erected for many of the works.

Associated with the gold in some of the Camarines ores are the sulphides of iron and copper in the form of pyrites, zinc in sphalerite, and crocoite, the chromate of lead. Gold is also found associated with the sulphides, arsenides, and antimonides of copper in the mines of Lepanto, district of Mancayan.

COPPER.

This metal has been reported from the Islands of Luzon, Mindoro, Masbate, Panay, and Mindanao, but the only important deposits so far known are those of the famous district of Mancayan, Lepanto Province, in northern Luzon. The report of copper in the Island of Balabac, the Paragua group, could not be verified by the mining engineer of this Bureau in a recent visit by him to that island; and Abella could find evidence of no valuable copper deposits among those reported from Panay. Samples of native copper, said to have been brought from Masbate, have been shown to the present Chief of the Bureau, but no information of value was obtained from the prospector exhibiting them. The copper deposits so far known in Mindoro are all of copper pyrites, apparently of limited extent; and of the ores reported from Mindanao nothing is known. There are veins of chalcopyrite in the Camarines and in Bontoc, but they have not yet been prospected or developed and data concerning them are not available at the present time.

The important deposits of Lepanto are at Suyoc and Mancayan, within a few miles of each other in the southern part of the province. These veins carry the sulphides, arsenides, and antimonides of copper, among them enargite, and its variety first identified here, luzonite. From samples obtained in the breasts of old workings at Mancayan it has been estimated that the ores average 16 per cent in copper, with a gangue of quartz. There is much of this ore in sight, and it is believed that in quantity and quality of copper Mancayan is one of the most inviting of the mineral assets of the Philippines. The deposits have been prospected, staked, and recorded, and the owners of claims are sanguine of success.

The working and smelting of the ores of Mancayan were carried on by the Igorrotes of Lepanto before the Spanish conquest. The metallurgical treatment was so ingenious, complicated, and effective that it unquestionably points back to an older contact with civilization, probably with the Chinese from the north. The mining, of course, has been most avaricious and the old workings will require thorough timbering before modern methods of exploitation can be employed. Of the many interesting features of the Igorrote metallurgy and of the first Spanish invasion of Mancayan nothing will be given here save that the natives made such excellent implements and utensils of copper, exporting them to the extent of 200 tons annually, that the attention of the Spanish was attracted; and that after an invasion with an armed force as an escort, amicable arrangements were finally made between the Cantabro-Filipino Mining Company and the Igorrotes by which mines were opened and worked under the distinguished Spanish inspector of mines, Jose Maria Santos, and that from two mines for the ten years following 1864 about 1,100 tons of copper were annually produced. Upon the death of Santos, who made a success of the Mancayan, mining was stopped.

It is hoped that as a result of fieldwork, recently completed in Lepanto by a party from this Bureau under Mr. A. J. Eveland, geologist, a fairly complete bulletin upon this interesting subject may soon be in press.

LEAD.

But little is known of lead deposits in the Islands, and there is reason to believe that their distribution is not wide. Crocoite, the chromate of lead, occurs with gold ores in the Camarines, but it has not so far been found of economic importance. Galena, the sulphide and common ore of lead has been found in Bontoc, the Camarines, Marinduque, and Cebu. The ore from Torrijos, Marinduque, has been reported to give the following average assay:

Lead	56.55
Silver	.0096
Gold	.0006

But no detailed account of the deposit is at hand. The galenas from Acsubing and Panopoy are reported by Abella as lying within true Stockwerks. Their content of metal as given by assays are, according to Abella:

Lead	47
Silver	.031
Gold	.062

These assays would appear to have been of specimens rather than of true samples of the ores.

SILVER.

Silver ores have not yet been discovered in the Philippines. The silver occurring here is in argentiferous galena or alloyed with the gold.

PLATINUM.

The Mining Bureau is now investigating an occurrence of native platinum in the gold-gravel deposits of Rizal. From present information platinum and associated rare metals do not seem to be of sufficient amount in these sands to be of economic importance; but the identification of platinum in the Philippines, after many reports of its occurrence hitherto unconfirmed, may lead to renewed search in similar fields.

ZINC.

This metal has so far been found only as sphalerite in unimportant and unwelcome amount in a few of the gold veins of the northern Camarines.

TIN.

Tin has not yet been discovered in the Philippines. A deposit of stream tin was reported at Alfonso XIII, on the west coast, by the natives of the east coast of Paragua, but opportunity has not yet been offered for a verification of this report. As the Moros of southern Paragua are affiliated with their Mohammedan brothers of Borneo and the Straits, and as the natives of the Straits are familiar with cassiterite and stream tin, there is a bare possibility of likelihood in the report.

MANGANESE.

A large deposit of rich manganese ore has recently been found upon the Island of Masbate, but at the present time no details of its occurrence are at hand.

IRON.

Important deposits of magnetite and hematite are found in Abra Province, in San Miguel and Angat, Bulacan, in Bosoboso, Rizal, and in the Camarines. The deposits of Bulacan are extensive and can be readily worked. Several of the ores are suitable for the manufacture of Bessemer steel, and one of the Angat ores is notable in that it contains cobalt in appreciable amount.

The natives of San Miguel and Angat have worked these ores in small charcoal furnaces for over a century and have established a good reputation and trade for the plowshares they produce. Following are some analyses by the Bureau of Government Laboratories of samples of Bulacan ores recently taken by the Mining Bureau:

Ore.	No. 1, hematite.	No. 4, magnetite.	No. 5 B, hematite.
	Per cent.	*Per cent.*	*Per cent.*
FeO	1.9	32.3	2.6
Fe_2O_3	88.2	48.7	84.2
MnO			
CaO	.1	Trace.	.3
MgO	.2	1.3	.1
Al_2O_3	6.5	15.3	8.7
FeS_2		Trace.	Trace.
CO_2		Trace.	Trace.
H_2O	.1	.1	.3
SiO_2	2.2	2.2	3.8
P_2O_5	Trace.	.1	Trace.
TiO_2	.8	.1	Trace.
Total	100	100.1	100

The ores of Bulacan will undoubtedly furnish excellent charcoal pig iron. Vast quantities of limestone for flux are available in the immediate vicinity of the ore beds, water transportation can be had upon the Rio Grande de Pampanga and the Angat River, and a branch of the Manila and Dagupan Railway through San Miguel and within 10 miles of the mines will soon be built and in operation. The charcoal can be had of sufficient quality and amount, but not at present at a very low price.

Further information concerning the iron ore deposits of Bulacan can be found in Bulletin No. 3 of this Bureau, "A Report on a Geological Reconnoissance of the Iron Region of Angat, Bulacan."

MERCURY.

This valuable metal has frequently been reported from various localities in the Camarines and in Panay, but in almost every case its occurrence has been disproved. On Mount Isarog, in the Province of the Camarines, however, there is every reason to believe that cinnabar and native mercury have been found.

ANTIMONY.

Specimens of the sulphide of antimony, stibnite, were found in small quantities in a nipa house on the south slope of Mount Maquiling, in Batangas, by Capt. F. V. Krug, of the Twentieth Infantry, during the Malvar campaign. The native showing this to Captain Krug told him that he could lead him to a deposit of the metal in the vicinity. This is the only information now at hand, excepting that the sample brought to the Mining Bureau was a group of characteristic crystals of pure stibnite.

COAL.

The most important of the mineral resources of the Philippines is probably the best grade of lignite coal. This is of Tertiary age and similar in all most important respects to that of Wyoming, Washington, and Japan. The best coal is free from sulphur and relatively low in moisture and ash. It is known in the Island of Batan, Albay Province; in Bulalacao, and Semarara, southern Mindoro; in Danao and Compostela, Cebu; on the Gulf of Sibuguey, in southeastern Mindanao; at Calatrava, Negros; and at Bislig, in eastern Mindanao. Some of the coal of Abra, Rizal, and eastern Negros is also believed to be suitable for use in steamships and in stationary furnaces now burning Japanese and Australian coal. A division must be made between the jet black, comparatively hard coals, probably of Eocene age, and the brown wood coals, much softer and more friable, of later age, and in large part not suitable for transportation. Both coals contain pyrites in some seams or portions of seams, but the black coal can, in most cases, be mined free from sulphur in this objectionable form. The brown coals are not of sufficient value, compared with older coals, to justify the expense of working at the present time. The best black coals are many of them strong enough for transportation, can be mined at reasonable cost, and presumably at a good profit, and should largely take the place of imported coals in the Philippines. Their fuel value is from two-thirds to three-fourths that of the best Welsh coal, very little short of that of the Australian, and equal to that of many of the Borneo and Japan coals, which they strongly resemble.

The thickness of the seams of the black coal varies from a few inches to 18 feet. A very large number of the best seams are from 3 to 5 feet thick. They lie with variable dip from 0° to nearly 90°, and in some fields the beds are irregular, twisted, and faulted. Careful and thorough prospecting with drill, such as is being carried on by Lieutenant Wigmore in Batan, should precede extensive development in most of the fields of the Philippines. Sufficient mining has already been done in the Danao and Compostela coal fields of Cebu to demonstrate the value of the deposits there.

It is hoped that a large, important, and profitable industry awaits the colliery companies of the Philippines.

For more detailed information, including maps and tables of analyses, reference is suggested to the Coal Measures of the Philippines, prepared by the Hon. C. H. Burritt, late Chief of the Bureau, and published in Washington for the Mining Bureau.

For convenience the following table of localities, where coal of various grades has been found, is appended herewith:

Vicinity of—	Province.	Vicinity of—	Province.
Amulong	Cagayan.	Bulalacao	Mindoro.
Dolores	Abra.	Semarara	Do.
Aringay	Union.	Balete	Capiz.
Polillo	Infanta.	Beernanga	Do.
Norzagaray	Bulacan.	Valderrama	Do.
Montalban	Rizal.	Dingle	Iloilo.
Tatamiran	Do.	Talabe	Negros.
Taytay	Do.	Calatrava	Do.
Atimonan	Tayabas.	Luzon	Do.
Alabat	Do.	Danao	Cebu.
Pagbilao	Do.	Toledo	Do.
Chico	Do.	Balamban	Do.
Macaleton	Do.	Asturias	Do.
Pasacao	Camarines.	Compostela	Do.
Caramuan	Do.	Naga	Do.
Catanduanes	Albay.	Dinagat	Mindanao.
Batan	Do.	Siargao	Do.
Libon	Do.	Saucop	Do.
Gatbo	Do.	Casauman	Do.
Loquilocon	Samar.	Matli	Do.
Gandara	Do.	Gran	Do.
Paranas	Do.	Naañan	Do.
Cataingan	Masbate.	Bislig	Do.
Subaan	Mindoro.	Sibuguey	Do.

A large and continued demand for coal is assured in Philippine waters, and it would seem that these Islands are geographically situated favorably to the furnishing of coal to meet the enormous demand of Hongkong and other near-by ports.

SULPHUR.

Sulphur occurs in limited amount in the Island of Biliran, Province of Leyte, and has been worked there on a small scale by natives for many years. No deposits of value and importance are at present known.

PETROLEUM.

Petroleum has been found in Tayabas Province, where it is understood some development is now going on, and at Toledo, Asturias, and Alegría, on the west coast of Cebu. A well was operated for a short time in Toledo, but since the war work has not been resumed. There may be a future for the petroleum industry in the Philippines; and although but little is known of the value and amount of this important fuel at the present time, much interest of late has been shown in its exploitation, and it is hoped that before long reports of value can be made.

SALT.

There is reason to believe that large beds of rock salt occur, without outcrops discovered as yet, in the mountains of Nueva Vizcaya. Streams gushing out from the hillside at Dapol are so heavily charged with brine that the natives by evaporation obtain important quantities of very pure salt.

GYPSUM.

The sulphate of lime in the form of crystalline gypsum and gypsum earth is found in Rizal, Laguna, and other provinces of the Islands. Much of this might be calcined for the production of "land plaster" and plaster of Paris, but none of it seems to be so used. The natives work the beds of white gypsum earths for use in whitewashing, and so far as developed this business pays very well.

LIMESTONE.

Large and important deposits of limestone are found throughout the Islands. In many provinces the rock is quarried and calcined, producing excellent lime that brings a very good price.

A cream-colored limestone of Bulacan seems well adapted to the making of hydraulic cement, and a deposit of similar rock has already been located and recorded in Rizal Province with the industry in view. An analysis made in the laboratories of Stanford University shows this rock to be a natural cement. This important and profitable use of Philippine limestone is now occupying the attention of the Mining Bureau and the Bureau of Government Laboratories.

Marble, or crystalline limestone, occurs in the Islands of Romblon and Mindoro, and probably elsewhere in the group. This is a gray-blue mottled marble and much of it seems very suitable for decorative use. White crystalline marble has recently been found by the Chief of this Bureau in Mindoro in considerable amount.

CLAYS.

White clays, or kaolin, have been found in the Provinces of Abra, Camarines, Ilocos Norte, Antique, Benguet, Cagayan, Isabela, Laguna, Marinduque, Masbate, Pampanga, Pangasinan, Albay, Romblon, and Zambales. The suitability of these for the manufacture of porcelain and china is now being investigated.

Red clays, from which natives make large amounts of pottery for local use, are found in almost every province in the Islands. The statistics and technology of this important industry are under investigation at the present time.

Fire clay has been found in the coal beds, and may afford a profitable industry in the future.

Red bricks are made in large quantities in Bulacan, Capiz, Rizal, Ilocos Norte, Isabela, Marinduque, Masbate, and Pampanga.

BUILDING STONE.

The Philippine resources in stone for building and other construction work, and road metal, are almost unlimited. Among the hard, crystalline rocks, capable of standing heavy pressure, of resisting weathering, and of taking a high polish, should be mentioned the fine gray diorites of the Cordillera, found in almost every province upon the western slopes of the range, and in Paragua, the gray tonalites, or quartz diorites of Tinagon and Colasi, Panay, equal to many of the best granites, and a rock, apparently a true syenite, or hornblende granite, recently found in Masbate. Augite andesite is now being extensively quarried by the Atlantic, Gulf and Pacific Company at Mariveles, for the works of the improvement of the port, and a volcanic tuff, soft when quarried but hardening rapidly upon exposure, is quarried in large amount and at good profit at Meycauayan, Bulacan, and Guadalupe, Rizal, and elsewhere for building stone. This rock has been used in enormous quantity in the construction of churches and other buildings in the Philippines, and in the walls and fortresses of Manila. Crushed andesite has been extensively used in street work in Manila and has made excellent road metal. A large variety of the neo-volcanic rocks have been used, in addition to gravel, for similar purposes by the provincial supervisors in the construction of roads.

GUANO.

A number of important deposits of bat guano have been discovered throughout the Islands, largely in the extensive limestone caves. Some of these have been located and recorded, but it is not known to what extent they have been worked. It is probable that they are all of limited amount.

PRECIOUS STONES.

With the exception of opal, reported from Binangonan in Rizal, and some very small rubies, reported in the head waters of streams flowing into the ocean near Mambulao and Paracale, no minerals have yet been identified as precious stones.

CONCLUSION.

From the above brief résumé it will probably be gathered that, although some of the common metals are absent, or not yet discovered, in the Philippines, there remain sufficient mineral resources to form the basis of an important industry. The stage at present is that of investigation and development; it is hoped, however, that we shall rapidly approach the period of production.

Further development of the mineral resources of these Islands is necessary to growth of the industries involved. Prospecting has been done upon almost every island of the group to the great credit of the pioneers who have laboriously blazed the trail; but capital for the development of prospects has been difficult to secure. It is hoped that the definite policy concerning the future of these Islands, so earnestly desired by capitalists as a prerequisite to permanent investment here, may soon be determined by the people of the United States, to the end that the Philippines may enter upon an undisturbed and prosperous career.

A welcome feature of the present interest in the Philippine mining is the increasing attention being given to the mineral resources by the natives of the Islands. Their interests are those of all; with their hearty coöperation it is hoped that the labor required may be more rapidly secured, that they will realize the common benefit of all mining activity, and that they may in time point with pride to the work and worth of Philippine mines.

FINANCES OF THE BUREAU.

Accompanying this report, as Exhibit A, is a tabular statement of the expenses of the Mining Bureau for the fiscal year 1904. As the year just closed represents the Bureau largely under the previous organization, and as the reorganized Bureau, with far wider scope and with necessarily increased field force, will require larger appropriations for the prosecution of its work than have heretofore been given, it is contemplated that the expense account for the fiscal year 1905 will show an increase; it is hoped with equal confidence, however, that the valuable results of the Bureau work will be proportionately greater.

RECOMMENDATIONS.

In concluding this report the Chief of the Mining Bureau has the honor to present the following recommendations looking to the future improvement of the value, respectively, of the Philippine mineral industry and of the Mining Bureau, requesting favorable consideration for improvements so earnestly desired.

First. That the Congress of the United States repeal section 33 of the act of July 1, 1902, leaving such restrictions for preventing exploitation at the expense of the Filipinos, if such be required, entirely within the jurisdiction of the Honorable Philippine Commission.

Second. That provision be made for permanent quarters for the present and future needs of the Mining Bureau at the earliest practicable date.

Respectfully submitted.

H. D. McCaskey,
Chief of the Mining Bureau.

To the honorable Secretary of the Interior.

Exhibit A.—*Financial statement, fiscal year ending June 30, 1904.*

	Allowed.	Expended.	Balances.
First half year:			
Salaries	₱8,600.00	₱7,436.24	₱1,163.76
Transportation	576.00		576.00
Contingent expenses	1,775.00	1,762.64	12.36
Second half year:			
Salaries	10,800.00	11,253.79	[1]453.79
Transportation	1,800.00	1,504.55	295.45
Contingent expenses	1,518.92	1,238.35	280.57
Total	25,069.92	23,195.57	1,874.35

[1] Deficit.

EXHIBIT B.

ADVANCE REPORT OF FIELDWORK IN LEPANTO-BONTOC.

THE MINING BUREAU, *Manila, August 8, 1904.*

SIR: In compliance with your instructions of February 12, 1904, and of February 20, 1904, I have the honor to submit the following advance report of fieldwork under my charge during the months of February, March, April, May, and June of the present year.

The fieldwork assigned was the examination of the mineral deposits of the Province of Lepanto, these deposits being two more or less closely identified areas in the southern part of the province. The two districts are the "Mancayan" copper district, taking its name from the small town of Mancayan in its center, and that of "Suyoc," which similarly takes its name from the barrio of Suyoc. The region, particularly Mancayan, has been fairly well known throughout the Islands by mining operations carried on by an organized company, dating back to the middle of the last century, and controlled by Spanish interests, and to an unknown remoter date when operations were carried on by the native—the Igorrote.

The party from the Mining Bureau was organized as follows: Mr. A. J. Eveland, the geologist in charge; Mr. H. M. Ickis, field assistant, and two American rodmen.

After considerable delay, the party embarked, February 23, on the Coast Guard steamer *Masbate* (Captain Stewart), and three days later the landing at Candon was made. Considerable difficulty attended the latter, owing to the rough sea, and the native Ilocanos manning the native viray used, having nothing to lose by a wetting, all but ended the trip then and there.

Bull carts were obtained to take the equipment and party to the town of Candon, which is a few miles from the beach, and, owing to the sagacity of the carabao in not working during the heat of the day, almost the entire day was consumed in getting to the plaza. Here tents were pitched and preparations were made for the trip over the trail to Mancayan.

By telegraph, cargadores from Cervantes had been requested, and a delay of four days ensued before they put in an appearance. In the interval instruments were adjusted, observations made on Polaris (Ursæ Min.) for true azimuth and latitude, and the bench marks of the coast survey looked up by means of a map furnished by the Coast and Geodetic Survey. By this means a number of the triangulation stations of the coast survey were located, and from station "Long. 1901, Candon" a traverse was run into camp, the camp station being used for the Polaris observations. From this point, also, the route survey had its origin, and work was immediately commenced upon it; so that when the party started, several miles had been run in advance, serving to get the instruments in working order, and to "break in" the rodmen, who were inexperienced.

During this period, also, an investigation of the geologic conditions in the immediate vicinity of Candon was made as far as practicable, the occurrence of tilted shales, with a northeasterly dip of about 40°, all or a part of which may later prove to be tuff or ash beds, being observed, particularly in the low hills about 2 miles to the east of the town.

The route of the party was via Salcedo to Concepcion, the first night's resting place. The rolling country before reaching Salcedo was so thickly vegetated and the trail so tortuous that it was seen very early that a route survey was out of the question if a rapid march was to be made to the final destination, so that survey was abandoned for the time. From Salcedo on the trail follows closely the bed of the Balidbid River, thirteen crossings of the winding river being necessary before reaching Concepcion. The river was at its lowest, and no trouble was met with in making the day's march, but the bed showed unmistakable signs that great variations in volume of the river occur during the year. Some four months later, when the party made its way out via this same route, the difference in volume was seen and appreciated, and great delay ensued.

This section of the country is the gently sloping plain extending from the flat coastal area to the coast range. Rolling in nature, heavily wooded and numerous large streams crossing it laterally, it resembles greatly, though on a reduced scale, the southern part of the Piedmont plateau of the eastern United States, in Maryland and Pennsylvania.

As the upper waters of the river are approached, the topography becomes slightly more rugged and finally the base of the western slope of the range, here named the Cordillera del Teila, is reached. The trail turns to the north, following a northern branch of the river, and passing on the western slope of a fertile valley to Concepcion, which is situated on the western slope of the range. The latter was estimated to be about 3,000 feet in altitude at this point, the formation being clearly seen, even from the coast, to be tilted blocks of sedimentary strata dipping sharply to the southeast about 40°–50°. From the position of the strata which the Balidbid River cuts, it is evident that after various undulations across the area from the coast eastward, the strata are sharply tilted up on the Cordillera del Teila, the jagged crest of the latter marking a line of rupture, or a parallel to a more easterly anticlinal axis, erosion leaving the western side only. Huge beds of conglomerate material were observed west of Concepcion and the crest of the range was seen to be limestone, the latter underlying the conglomerates (whether true conglomerates or volcanic beds not determined) and shales noticed to the west.

Cargadores were changed at Concepcion, and after a night's rest the ascent of Teila Pass was begun. The trail is an old Spanish road zigzagging painfully upward, the barometer at the highest point reading 3,200 feet. To a height of perhaps 2,000 feet rice paddies accompany it, a tremendous amount of work being indicated in their construction.

From Teila Pass could be seen to the eastward the broad valley of the Abra River, the headwaters of the latter at the divide between Benguet and Lepanto Provinces, easily seen in the clear air. On the western side the scarp is abrupt, and the trail to Angaqui steep and difficult. On the east, the slope from the bed of the Abra to the Cordillera Central, which marks the western edge of Bontoc, is more gentle. The clearness of the air, and the almost total absence of timber in the valley proper, made every feature of the topography of an area, roughly, 25 miles wide by 40 miles in length, stand out clearly, a good view of fully 1,000 square miles of territory being visible.

The trail down to Angaqui, steep and rocky, coupled with a blinding glare, the reflection from the white limestone, was disagreeable. This limestone could be seen for miles to the south marking the crest of the range, and presumably occupied the same position to the north; under it was observed a much shattered and possibly altered material, whether igneous or sedimentary undeterminable until later closer examination, and then succeeded, shortly before reaching Angaqui, igneous rock, massive and in good condition.

At Angaqui, another annoying delay was met—the cause the usual lack of cargadores, or more particularly the lack, on their part, of willingness to work, conditions which the party had difficulty in learning to take as unavoidable. In twenty-four hours, however, part of the men were secured and as much of the equipment as possible was started for Cervantes, leaving Mr. Ickis to follow with the remainder. The party was provided with horses, through the kindness of Lieutenant Eckman, at that time senior inspector of Constabulary at Cervantes, and in a short day's march Cervantes was reached.

Everything possible that could make it agreeable for the Mining Bureau field party was done by the officials of the Government at Cervantes; their courtesy and kindness, and assistance in meeting the problems involved in the passage of the party, mark the most pleasant features of the trip.

At Cervantes the cargadore question is serious, and though the first detachment of the party, with Mr. Ickis accompanying it, making a survey en route, started within thirty-six hours, it was not until three days later that the last load went out of Cervantes. On March 10, sixteen days after the departure from Manila, the pueblo of Mancayan was reached, and we were at the field of operations. The trip had been one of spasmodic jerks and jumps, with tedious delays at every barrio in waiting for cargadores. The cargadores worked well under load and though the price for porterage has increased 200 per cent since the advent of Americans, the rates are not excessive. The main trouble is in securing the men, and this is traceable to the changed conditions since Spanish rule.

The day after our arrival was spent in pitching camp, the first location proving undesirable, and in arranging the outfit for a more or less prolonged residence, as it was intended to work, with this as a base, over a large area. The tents were pitched on a small flat about a quarter of a mile south of the town of Mancayan, within 50 yards of the former site of the mine manager's buildings when the Mancayan mines were in operation. Immediately to the west, about 500 feet below in the gorge of the Mangambang River, were the openings of the various tunnels of the old Mancayan mines, the smelter sites lying just to the northwest a few hundred feet; to the north and south for several miles were the location stakes and exploration pits of the American locators. A strip of land about 2 miles wide and 6 miles long has been covered by overlapping American claims, and over the area were numerous pits and shafts.

On the day following the arrival of the entire equipment topographic work was begun. A suitable site for a base line was selected, near the main trail, at a fairly level stretch, just north of Mancayan, at the little barrio of Cruz. Stakes were set at an interval of 100 feet, the distances determined accurately with steel tape and stadia measurements, repeated checkings satisfying the accuracy required, and then reduced to the horizontal. Triangulation stations were then set over the northern part of the area by Mr. Ickis, on suitable points for tertiary triangulation, referred to the base as laid out, the stakes being marked so as to be easily visible by the instrument man. Mr. Goodman, field assistant of the Mining Bureau, joined the party in the midst of this work, and after its completion reported at Manila. The triangulation stations were set as far south as Tuboc, midway between Mancayan and Suyoc, and then began the determination of the angles and distances of the triangles, and their computation and plotting.

During this preliminary work by Mr. Ickis a general inspection of the field was taken by the geologist. It was seen at once that a large area was involved and it would be difficult to make a detailed survey in as short a time as was at the disposal of the party. The plan of work decided upon, therefore, was to make a map of the entire region upon which locations had been made, on a scale of 400 feet to the inch of considerable accuracy. In connection with this topographic work an investigation of the geologic conditions over the area of the map would be made in as much detail as practicable, with especial reference to the mineral deposits, and also, on a broader scale, over a considerable area, extending from the slope of Mount Data on the east to the Malaya range on the west.

The topographic work, though originally planned for transit control, with filling-in methods by prismatic compass and aneroid barometer, was found much more satisfactory in this particular type of country when done entirely with the transit, distances and elevations being determined at one operation with the stadia. The method of operation was as follows: From a triangulation station a traverse was run to a position which could command as much as possible of the topography in the vicinity, and, with this point as a station, series of bearings, distances, and angles were taken to all map data, i. e., critical points of slopes, etc., claim stakes, shafts, tunnels, houses, and all other material, both natural and objects of man's handiwork, which were of sufficient value to place on the map. The area being covered from this point, another point was chosen in the same manner, and the survey continued. In case of the main trail, and several others, notably the old Spanish road to the mines and the "Belili" trail, and several more important streams, traverses were run directly following the course of the trail or stream, topographic data being obtained on both sides in connection; in this manner all the necessary topographic detail was obtained, sketches being constantly used to supplement the fieldwork, to insure greater accuracy in the final mapping.

On account of the mass of data necessary for the somewhat unusual topography of the region, it was found that the platting could not keep pace with the fieldwork. Any approximation to fairly exact geologic work calls for an accurate topographic map, as a basis for the locating of geologic conditions, and, with the limited force in the field, it was of course impossible to prepare enough map material sufficiently in advance, even for reconnoissance work.

The geologic operations, therefore, were reduced to (1) a reconnoissance of a general area of some miles on either side of the mineral district proper, the facts observed being located by bearings and altitudes from some transit or triangulation station of the survey which had already been located; (2) a general reconnaissance, descriptive in scope entirely, of as large an area as could be covered while en route from Candon to Suyoc, and in the Mancayan-Suyoc field; and (3) a detailed study of all shafts, tunnels, and other openings or exposures which had a direct bearing on the ore deposits of the district.

These three lines of attack were supplemented by study of the general features of the country, the timber, water, nature of the people, transportation problems, etc., which had a bearing on the development of the mineral deposits. In this connection all the miners in the district were seen and their views fully noted. In this general study over a large area some extremely interesting geologic conditions were seen, and when correlated with other observations in the future, considerable light will be thrown on the geology of the Islands, upon which there has been little systematic study.

Of the different varieties and classes of rocks found in this district, samples were gathered for purposes of both chemical, and microscopic and megascopic study; and, similarly, samples of veins and ores were taken where conditions permitted it. With this data, used in connection with the topographic map prepared by Messrs. Goodman and Ickis, a report on this region, covering all important phases of the subject, will be prepared in full.

When this work was far enough advanced so that all the territory around Mancayan had been mapped, camp was shifted to Suyoc, and pitched west of the town on the ridge marking the divide between the valley of the Abra River and the headwaters of the Pacat River, which is a tributary emptying its waters north into the Maanse, the latter joining the Abra later. From this camp the remainder of the Mancayan-Suyoc district was completed, and it served also as a base for the geologic work immediately near Suyoc.

Before leaving, the party established two permanent bench marks, one at the northern and the other at the southern end of the district surveyed (on rock in situ and of a durable nature), each bench mark being placed within a few feet of a triangulation station of the ground work, and the position of each was carefully checked.

When a general survey of the Islands is made, reference to these points from some primary triangulation survey will fix accurately the relative position of the Mancayan area. Observations were made for latitude and the true meridian by solar observation and also by direct observation on Ursæ Min. (Polaris), and at several triangulation stations bearings were taken to natural monuments with the same object of treating the area covered by the party, with reference to future surveys.

This closed the instrumental work of the party at Mancayan-Suyoc, and on June 22, after working for six weeks in almost constant rain, the party started to retrace its steps, via Cervantes and Candon, to Manila. A route survey covering the topographic features of the country traversed was made from Suyoc to Candon, under conditions which made accomplishment of the work most praiseworthy, and great credit is due Messrs. Goodman and Ickis, field assistants, and Mr. Riendeau, rodman, for this work in particular, and the manner in which work was carried out under almost impossible conditions, in general.

Arriving at Candon, the party found that, on account of the condition of the surf, it was impossible to get off to the Coast Guard steamer. The river between Candon and San Esteban being impassable, it was also out of the question to reach that place, where a landing could possibly be made. Recourse was had to bull carts, in which the equipment was taken south to San Fernando, and the arrival of some means of transportation awaited. During this interval, under receipt of telegraphic advices from Manila, a route survey, similar to that run from Suyoc to Candon, was made from San Fernando to Baguio. Upon the return to San Fernando, steamer *Harrisburg* was taken from San Fernando to Dagupan, and the railroad to Manila, the party arriving July 29.

The geologist in charge left the party at Cervantes and made his way out down the valley of the Agno River, through Benguet, to Baguio. As far as time permitted, the ground for the survey of Benguet mining district was looked over, in order to know in advance the character of work required. The properties at Antimok, which were convenient to reach in the short time allowed, were looked at hastily. This accomplished, the Benguet Road was followed to Dagupan, and from thence to Manila transportation was via Coast Guard steamer *Basilan,* railway communication being broken. February 24, the date of arrival in Manila, was five months to a day from the date of departure. This represented three months actually in the field, fully two months being lost on the way to and from the area surveyed; and even in making this allowance, it must be remembered that three months, or ninety days, was in reality much more than the actual time used in actual work. From early in May, through June, and even in April previously, rain fell almost every afternoon, rendering instrument work impossible and virtually cutting off every working day by at least a third.

Throughout the trip the health of the party was as a rule good. No serious illness affected any member of the party until at Baguio, en route to Manila, Mr. Goodman suffered for several days with a bad attack of fever. The trip proved pleasant and salubrious, the cold, although unpleasantly damp, air of the mountains proving a relief to the heat of the plains region about Manila. Although many obstacles and difficulties arose which are characteristic of geologic work in the Philippines, ways were found to overcome them, and the experience gained in this expedition will indubitably prove valuable in future work.

Respectfully submitted.

A. J. EVELAND, *Geologist.*

To Mr. H. D. McCASKEY,
Chief of the Mining Bureau, Manila.

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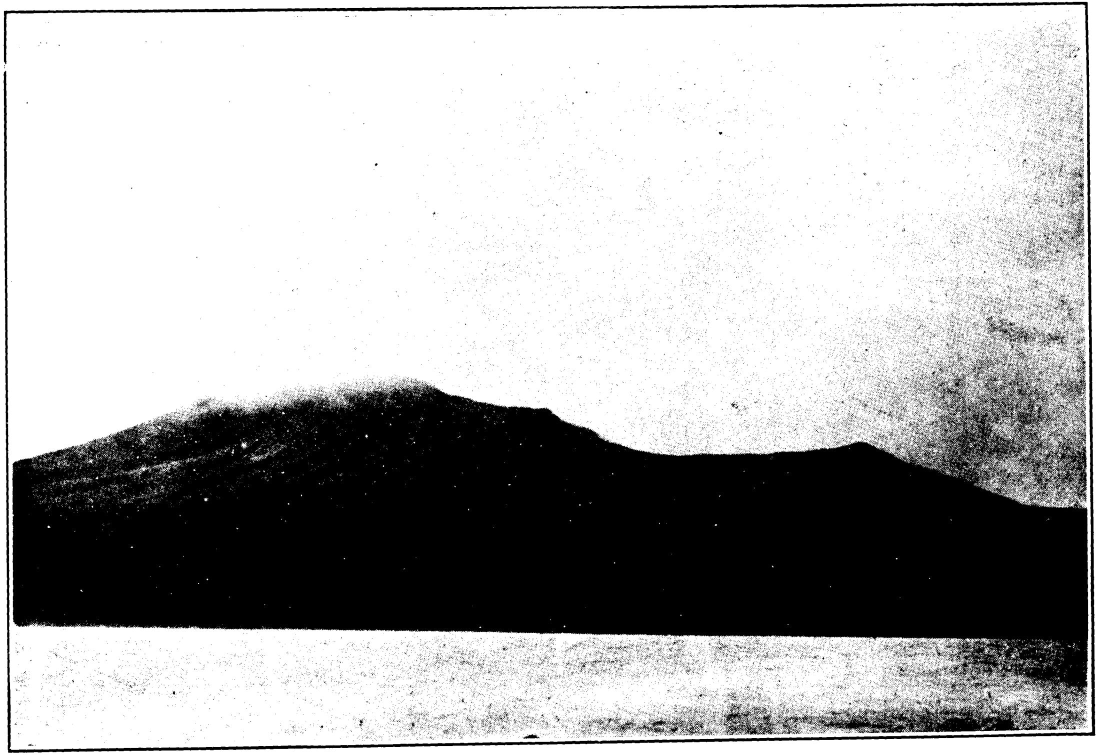

Photo by D. C. Worcester.

No. 1. TAAL VOLCANO. EAST SLOPE FROM LAKE TAAL.

UNIV. OF

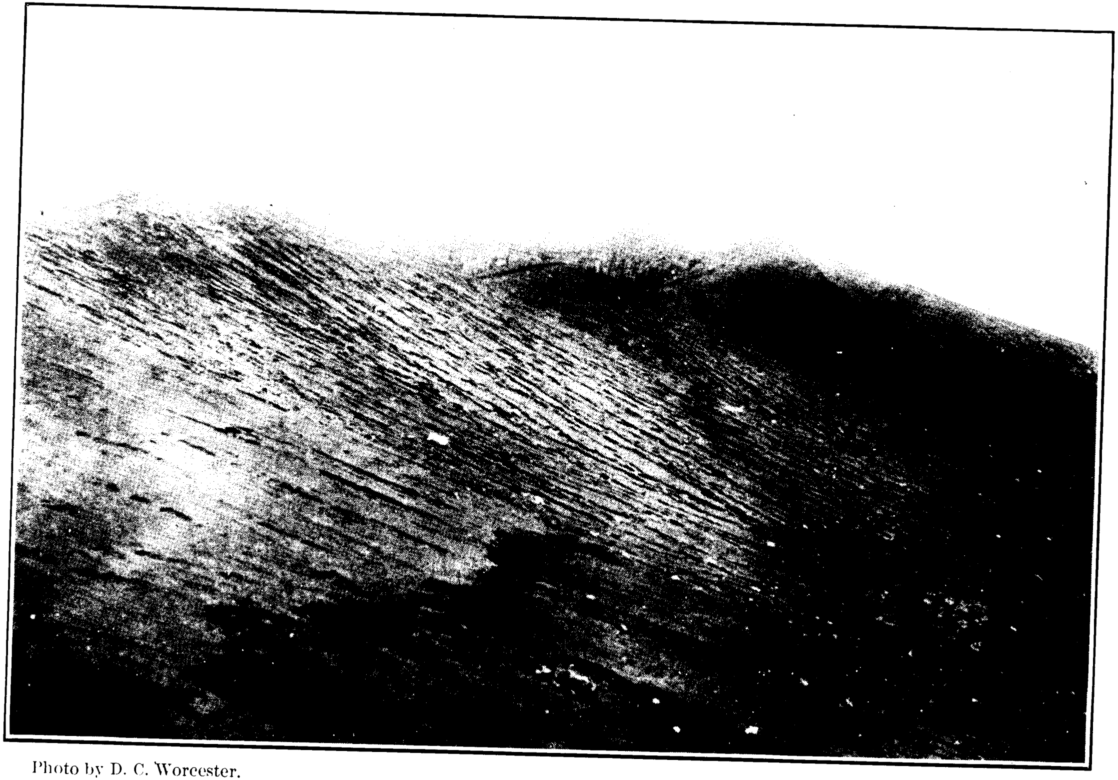

Photo by D. C. Worcester.

No. 2. TAAL VOLCANO. EAST SLOPE NEAR CRATER RIM.

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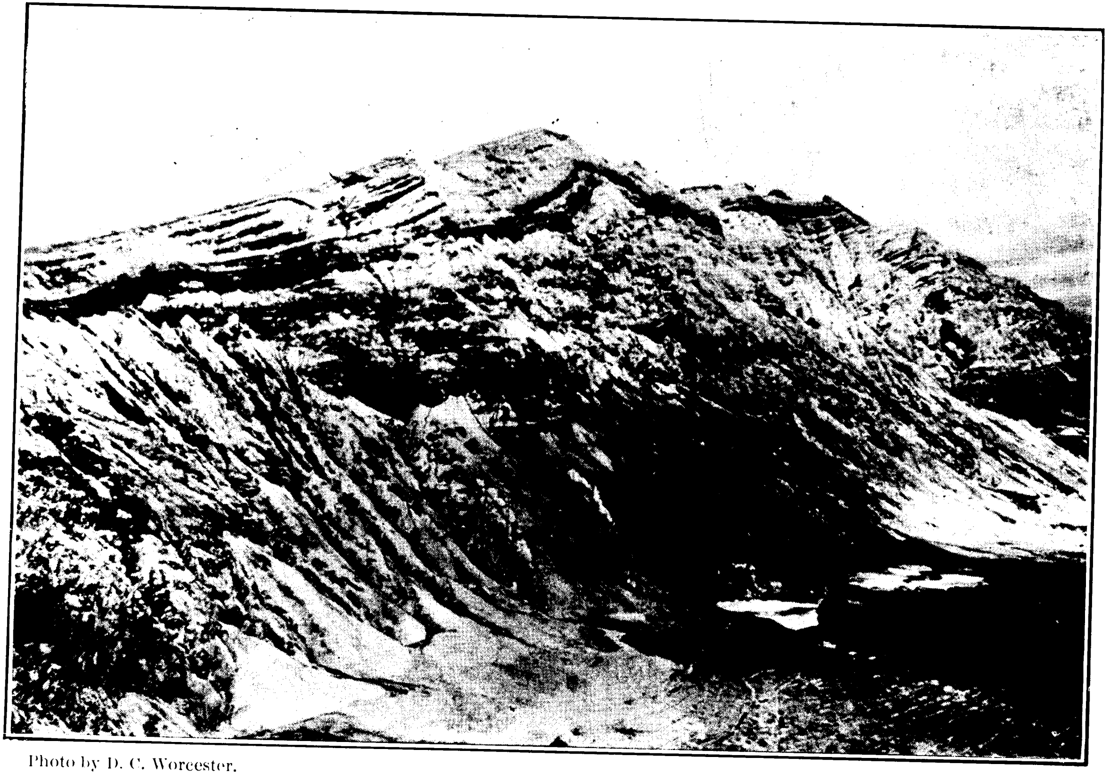

Photo by D. C. Worcester.

No. 3. TAAL VOLCANO. SOUTH WALL OF CRATER FROM EAST WALL.

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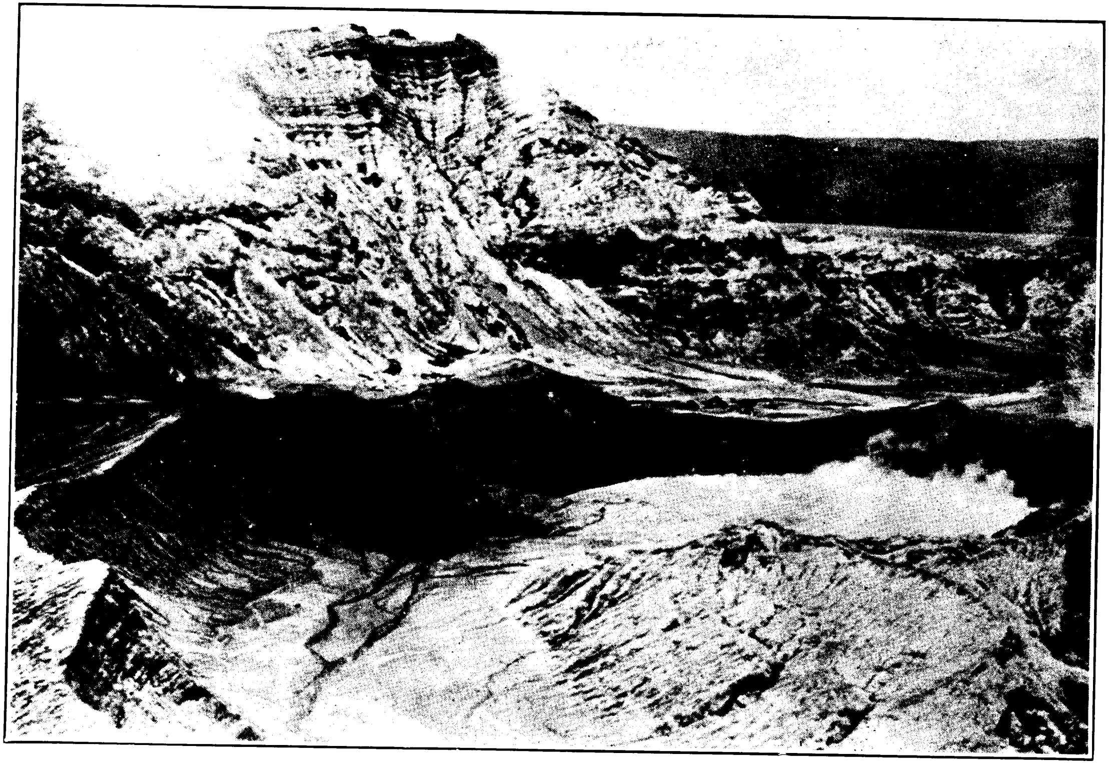

Photo by D. C. Worcester.

No. 4. TAAL VOLCANO. SOUTH AND WEST WALLS OF CRATER FROM NORTHEAST WALL.

UNIV. OF MICH.

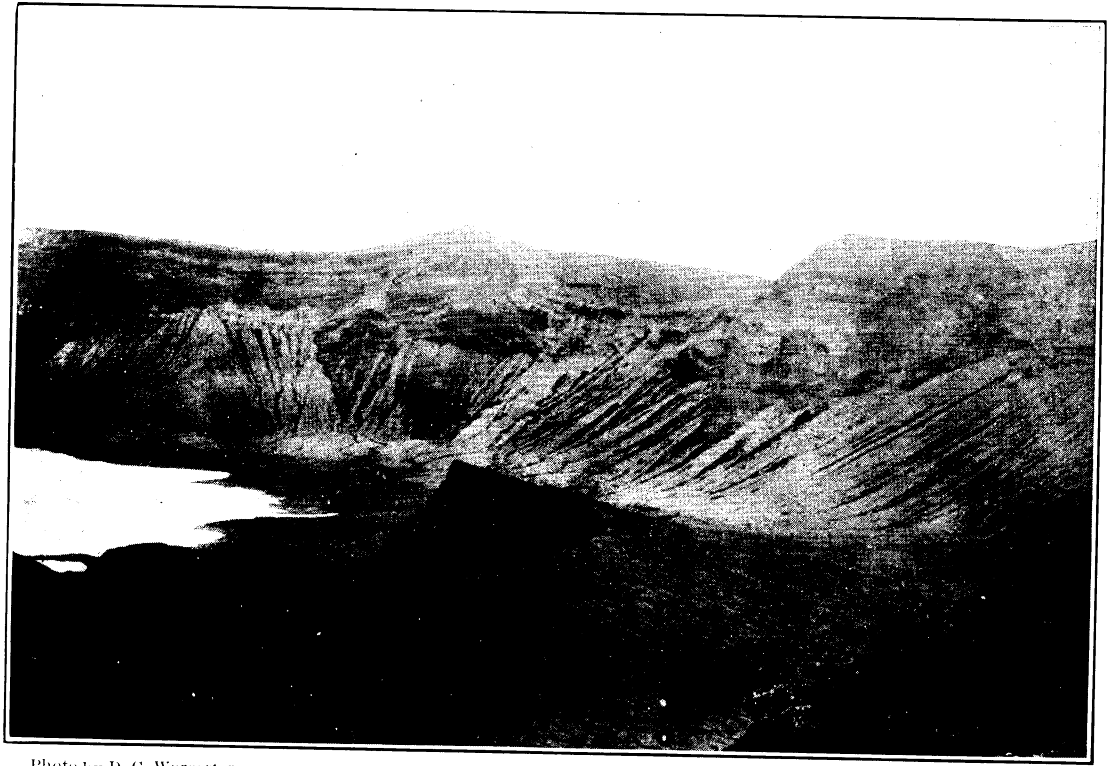

Photo by D. C. Worcester.

No. 5. TAAL VOLCANO. NORTHWEST WALL OF CRATER. NORTH END OF YELLOW LAKE. FRAGMENT OF SECONDARY INNER WALL. FROM EAST WALL.

UNIV.

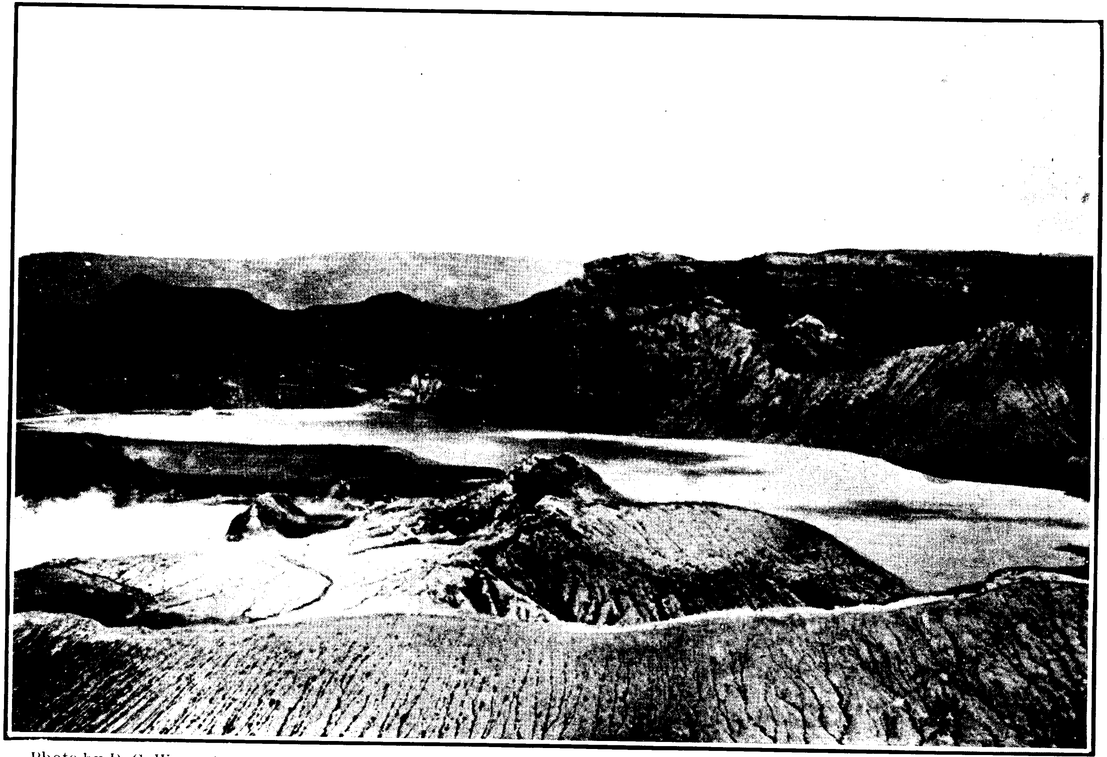

Photo by D. C. Worcester.

No. 6. TAAL VOLCANO. NORTH AND NORTHEAST WALLS OF CRATER. CONE, BININTIANG-MUNTI, IN BACKGROUND. SUNGAY RANGE IN DISTANCE. YELLOW LAKE BEYOND. GREEN LAKE AT LEFT. FRAGMENT OF SECONDARY INNER WALL IN FOREGROUND. FROM SOUTHEAST WALLS.

UNIV. OF

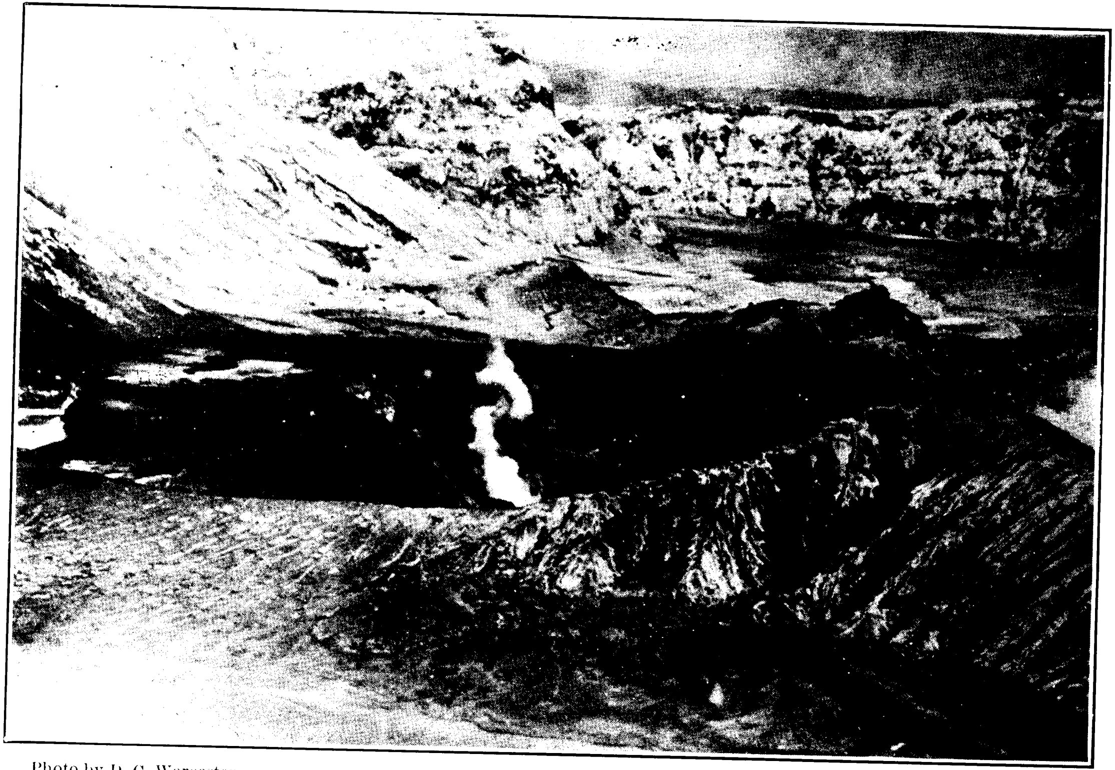

Photo by D. C. Worcester.

No. 7. TAAL VOLCANO. WEST WALL OF CRATER AND INNER CRATER QUIET. FROM EAST WALL.

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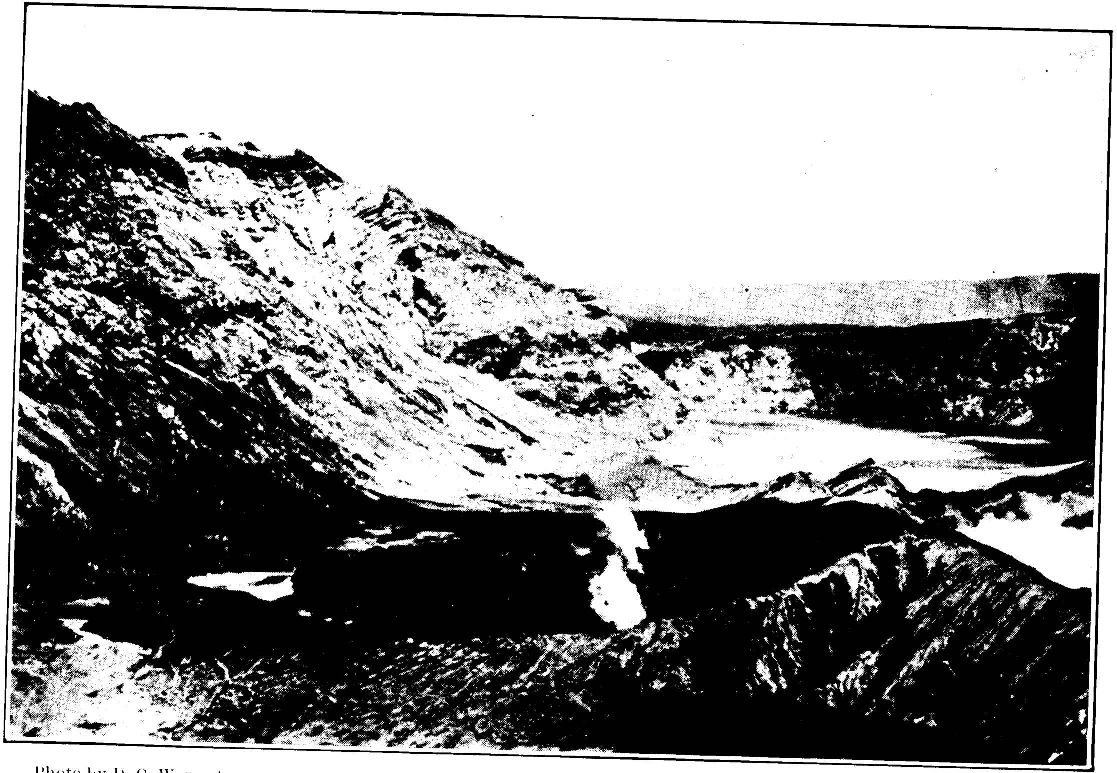

Photo by D. C. Worcester.

No. 8. TAAL VOLCANO. SOUTH AND WEST WALLS OF CRATER AND INNER CRATER QUIET. FROM EAST WALL.

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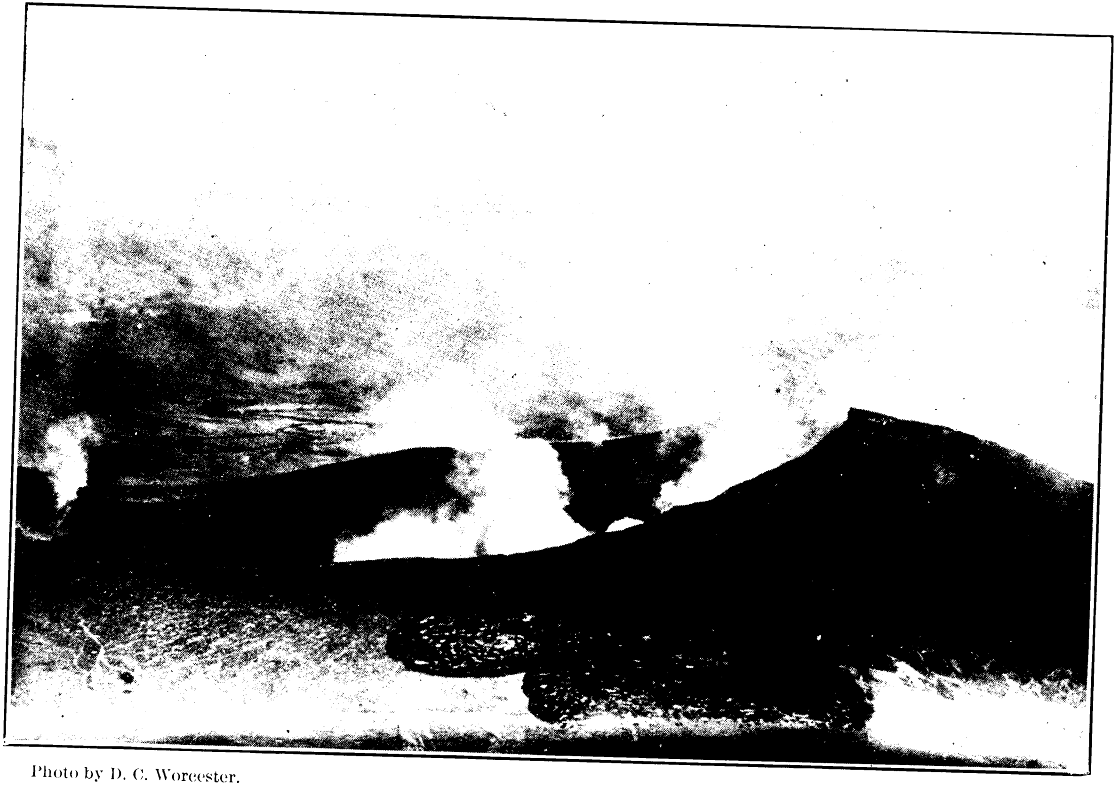

Photo by D. C. Worcester.

No. 9. TAAL VOLCANO. INNER CRATER BEFORE EXPLOSION. FROM EAST WALL, JULY 4, 1904.

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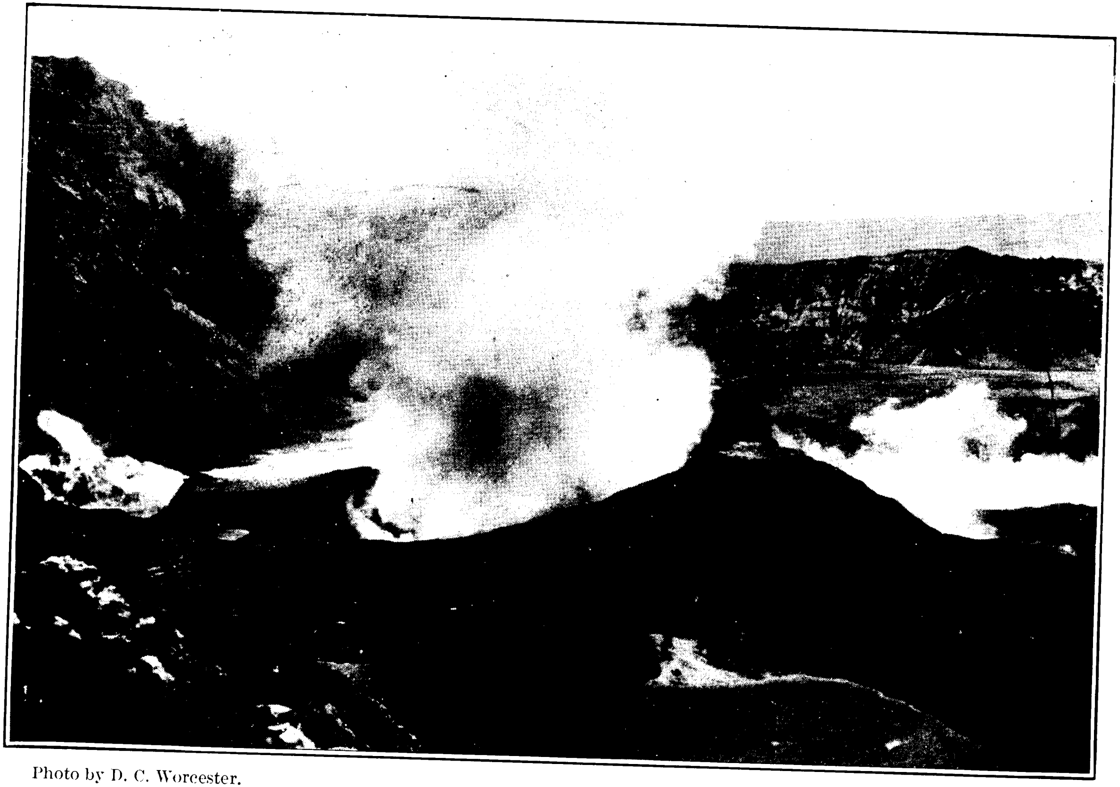


Photo by D. C. Worcester.

No. 10. TAAL VOLCANO. SOUTH AND WEST WALLS OF CRATER. INNER CRATER BLOWING OUT STEAM AND GASES. RED LAKE IN FOREGROUND. FROM EAST WALL, JULY 4, 1904.

UNIV. OF MICH.

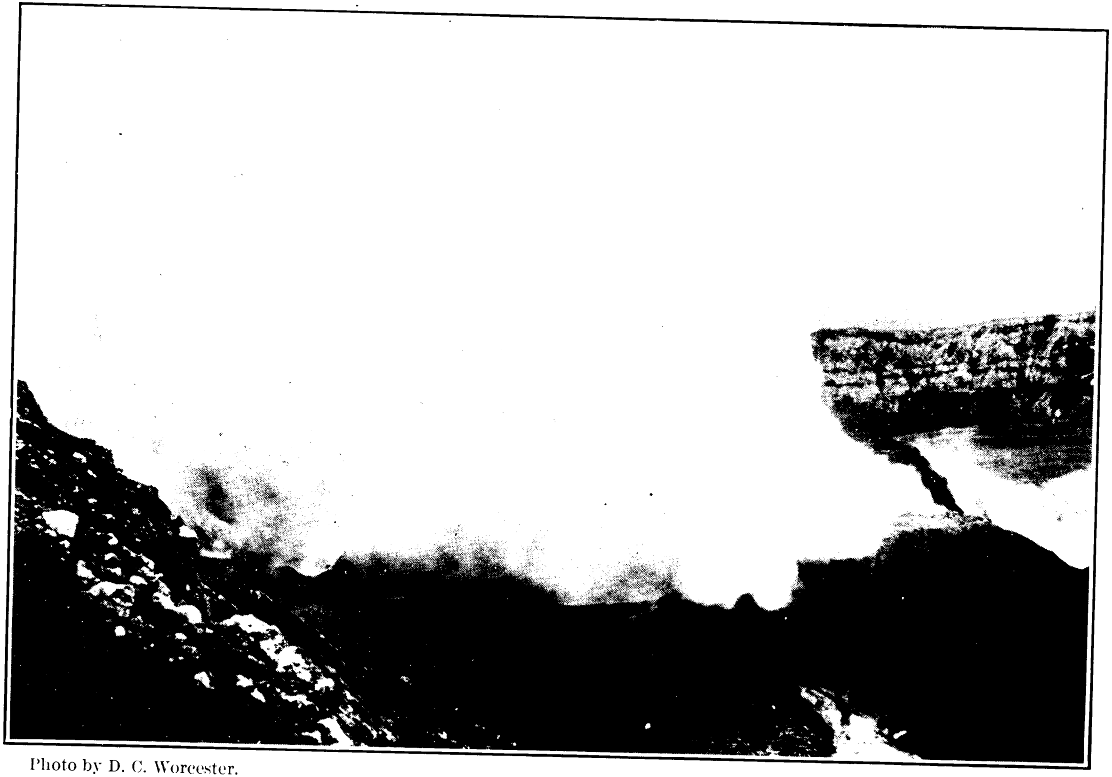


Photo by D. C. Worcester.

No. 11. TAAL VOLCANO. WEST WALL OF CRATER. INNER CRATER BLOWING OUT STEAM AND GASES. FROM EAST WALL. JULY 4, 1904.

UNIV.

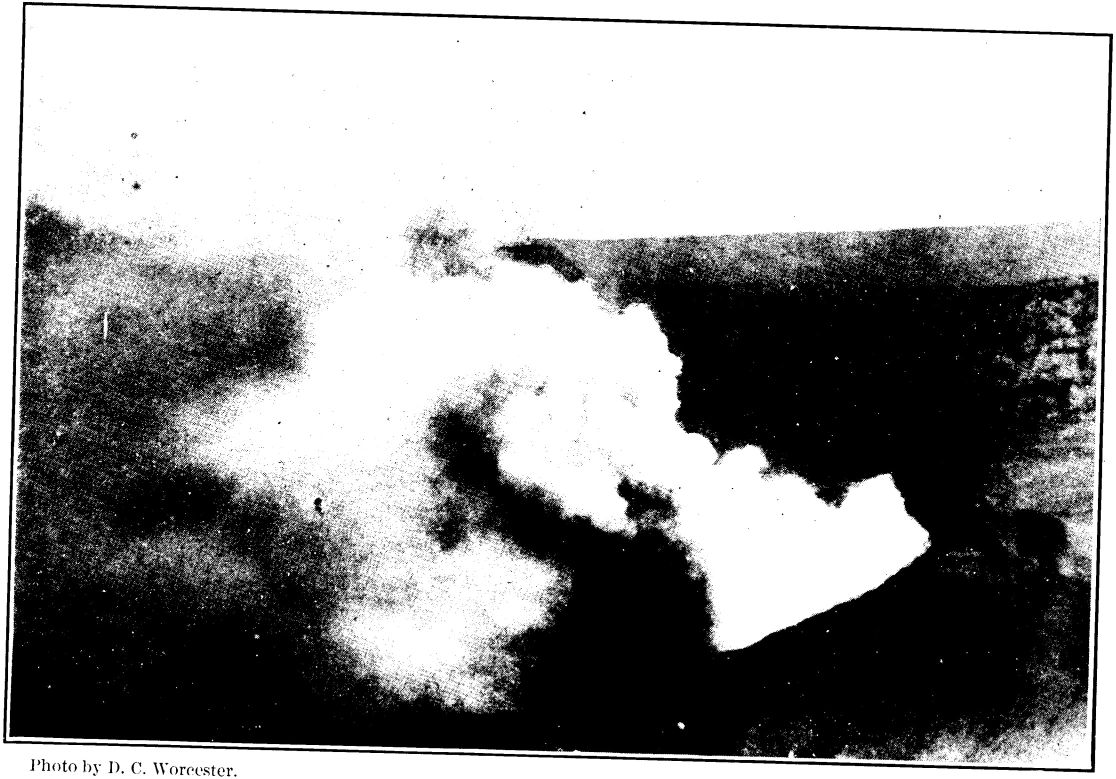


Photo by D. C. Worcester.

No. 12. TAAL VOLCANO. INNER CRATER EJECTING HOT MUD, STONES, STEAM, AND GASES. FROM EAST WALL, JULY 4, 1904.

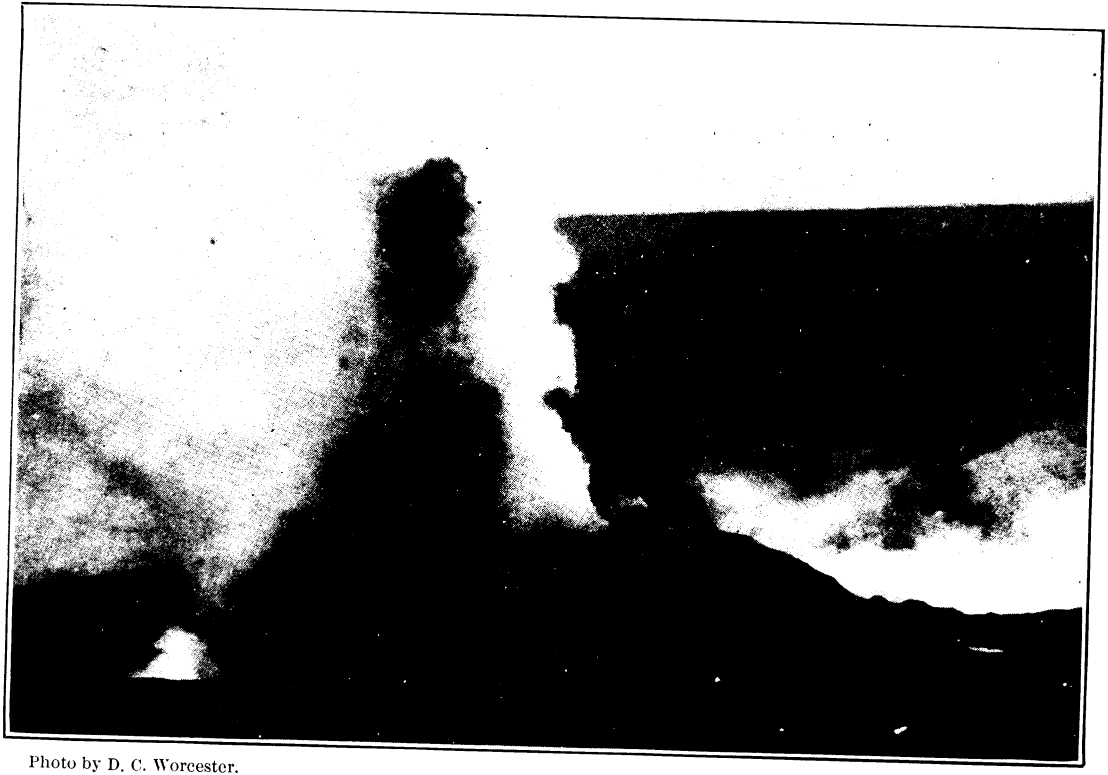


Photo by D. C. Worcester.

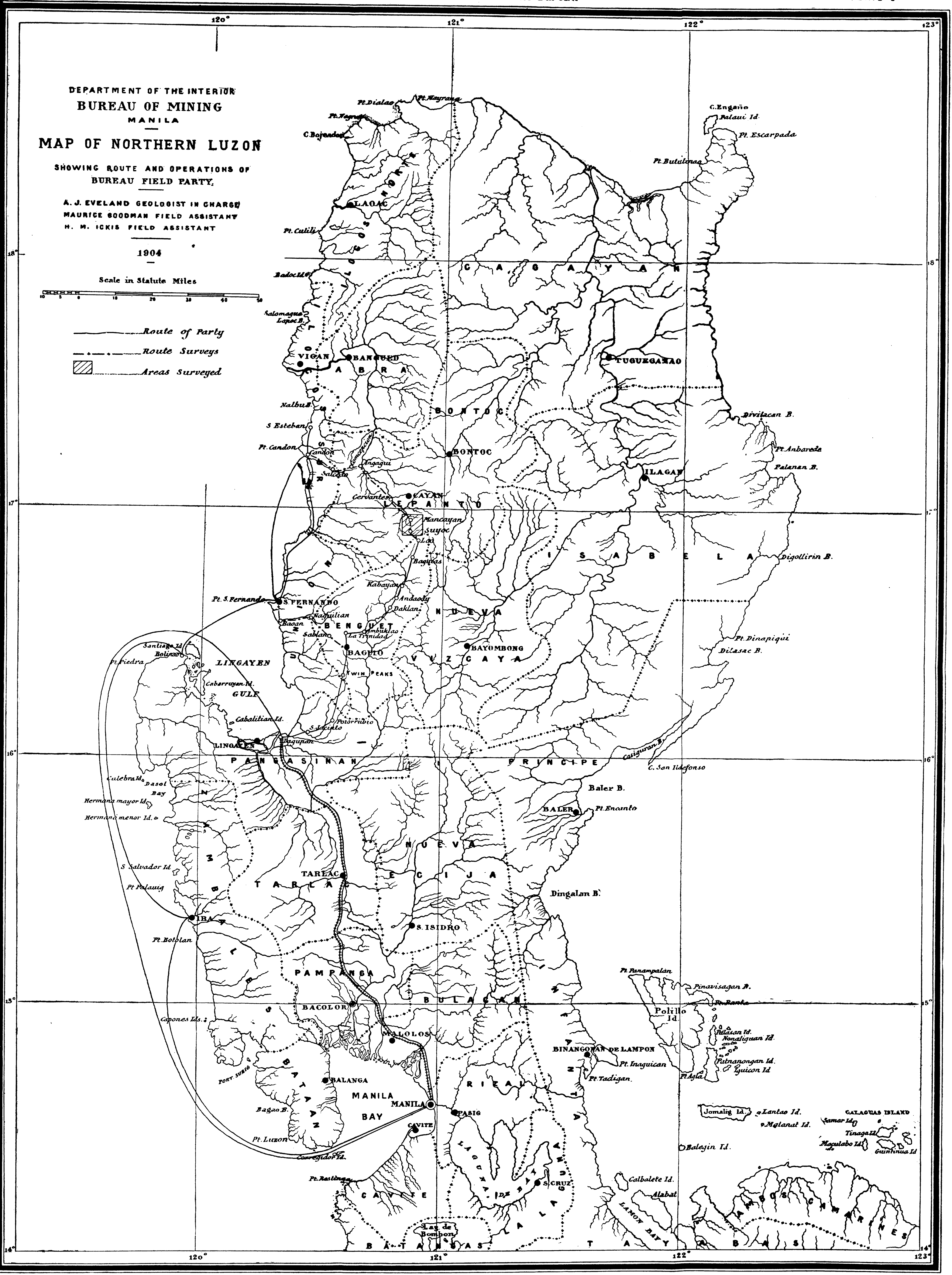
No. 13. TAAL VOLCANO. INNER CRATER IN VIOLENT EXPLOSION EJECTING MUD, STONES, STEAM, AND GASES. FROM EAST WALL, JULY 4, 1904.

UNIV. OF MICH.

THE MINING BUREAU

H. D. McCASKEY Chief of the Bureau

PLATE 1



TO ACCOMPANY ANNUAL REPORT YEAR ENDING AUGUST 31 1904

M. B.-3.

H. D. McCASKEY

CHIEF OF THE BUREAU OF MINING

Oversized
Foldout

SIXTH ANNUAL REPORT OF THE
CHIEF OF THE

MINING BUREAU

TO THE HONORABLE
SECRETARY OF THE INTERIOR

BY

H. D. McCASKEY
CHIEF OF THE MINING BUREAU

BEING FOR
THE YEAR ENDED AUGUST 31, 1905

MANILA
BUREAU OF PRINTING
1905

36326

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13. Native smelter camarin, Angat iron mines, Bulacan.

NOTE.—Photographs 1 and 2 are by A. J. Eveland, 3 to 11 by A. J. Eveland and Charles Martin, and 12 and 13 by Charles Martin.

SIXTH ANNUAL REPORT OF THE CHIEF OF THE MINING BUREAU.

MANILA, *September 15, 1905.*

SIR: I have the honor to submit herewith my report as Chief of the Mining Bureau for the year ending August 31, 1905.

BUREAU ORGANIZATION, RECOMMENDATIONS TO THE ORGANIZATION COMMITTEE.

During the past year the reorganization of the Mining Bureau, as provided for in Act No. 916 of the Philippine Commission, was completed by the appointment of Mr. W. D. Smith to the hitherto vacant position of geologist. This appointment was made on March 1, 1905, and was thus delayed by reason of the difficulty in finding a young man whose training fulfilled the exact qualifications desired. Mr. Smith has been especially selected to investigate the economic geology of iron, coal, and other deposits, chiefly stratified, in Philippine fields, and his training is such that it is hoped he will develop into a valuable man for this work.

The present Bureau organization is numerically small and the field covered is necessarily wide. The men at present engaged are all of them selected by me from best available material for their work, and they have already proved themselves competent in the many duties assigned to them. By even a cursory inspection of the range of these duties an idea of the required qualifications and the training preparatory and to be acquired may be had. To those appreciating the desirability of specialization and of concentration upon given lines of work it would seem unfortunate that the Bureau staff is so limited in numbers; and it would seem to the best interests of the mineral industry at this time that this force be immediately increased that all economic deposits of probable value may be investigated and reported upon at the earliest possible time. In view of the present necessity for retrenchment in expenses on the part of the Insular Government, however, recommendation to this effect can not yet be made; but still less is it possible for me to recommend that the present Bureau staff be curtailed in number, or that necessary field funds for future Bureau expenses be decreased in amount. The Mining Bureau as at present organized is the result of evolution and development from plans formulated by me three years ago, and it is now attempting to cover an important work with a minimum force. It is believed that economy is being secured throughout, and no efforts are being spared to this end. All work assigned is in accordance with my best judgment as to its importance, and no part of the work now being carried on by this Bureau can in my judgment be transferred for best results elsewhere. Notwithstanding the magnitude of its task, the work of systematic field investigation, and of working up in the office notes and data gathered on the ground, is being carried on with promise of definite and valuable results. Economy is practiced to what is believed to be the highest degree by the appointment of men so broadly trained that they are able to perform, under proper direction, all field and office work, from the preliminary survey to the published report. This has been the plan of the Chief of this Bueau since he first recommended the present reorganization and during the period of actual formative development to the organization of to-day.

In view of the above, and of additional similar considerations, when the Chief of this Bureau was interrogated by the organization committee appointed by Executive Order No. 14, series of 1905, to report upon the efficiency of Insular Bureaus and to make recommendations concerning them, he strongly recommended in a special report dated April 10, 1905, in which the purpose, work, plans, and costs of this Bureau are gone into in detail, that no reduction in force or field funds and that no "merging" or consolidation of this with any other Bureau be recommended by the committee.

The purposes and plans of this Bureau as authorized in Act No. 916 were also discussed, with quotations from this act, in the Annual Report for the year 1904, and it is believed that no further elaboration of them need be given here.

QUARTERS OCCUPIED BY THE MINING BUREAU.

In the report of this Bureau for 1904 attention was invited to the need for more commodious quarters for this Bureau, and particularly for rooms with sufficient light. The present quarters have the two distinct advantages, (1) that they are in a Government building acquired from Spain (the Casa Moneda at 358 Calle Cabildo, Intramuros), and that they are therefore of no expense to the Insular Government but that of repair; and (2) that they are situated in the Walled City, near the Ayuntamiento, and on one of the street-car lines. They have the great disadvantages of being poorly arranged for the purpose required, of being without sufficient light, of being too limited to accommodate present needs, and finally of being in need of repairs which at the present time it has not been considered advisable to recommend.

Recommendations of this Bureau for 1903 and 1904 are respectfully repeated to the effect that provision be made for the second floor of a suitable wing to be added to the new building of the Government Laboratories, to be set aside and properly furnished and equipped for the use of the Mining Bureau.

OFFICE WORK: EXECUTIVE, CORRESPONDENCE, EXCHANGES, PREPARATION OF REPORTS AND MAPS; TRANSFER OF TECHNICAL LIBRARY.

The office work of this Bureau has steadily increased during the past year. The time of the Chief of the Bureau is mainly occupied in equipping and directing field parties, in supervising the divisions of work carried on in Manila and in the field, in securing and furnishing information concerning the mineral resources and industry, in extending assistance to those actually or prospectively engaged or interested in the development of this industry, in providing for the needs of the Bureau, and in general in undertaking to carry out, with his loyal and efficient assistants, the purposes for which the Bureau was organized under Act No. 916. These duties, involving much correspondence and occasional delays, and meeting at times with negative results, have been greatly lightened by the harmonious working of the Bureau as a whole, by the cordial coöperation of fellow-officials—municipal, provincial, and Insular—and by the active support and assistance generously given by business men in Manila and elsewhere and by miners and prospectors wherever they may be found. It is a pleasure to record the natural but by no means the obvious or necessary fact that those whom this Bureau has striven most earnestly to serve have almost invariably given it their most cordial support.

The preparation of material for reports following upon field work and of special reports to the Chief of the Bureau, and the performance of general technical work assigned, constitute the office work of the two geologists and the two field assistants of the technical force. This preparation consists in working up all data obtained and all field material gathered, including general, geologic, economic, and topographic notes, fossils, rock and mineral samples, illustrations, and maps. The personnel of the Bureau has been so selected that the entire work required, with the exception of some photographic and all quantitative analytic chemical work, is performed as natural subdivisions of its work within the Bureau. The exceptions are subdivisions of the work of the Bureau of Government Laboratories, and are efficiently performed therein upon request. The maximum economy is, it is believed, obtained under present conditions in this way. The four technical assistants are expected to confine themselves to work to which they are especially assigned, and all executive and supervisory work is undertaken by the Chief of the Bureau, to whom the various members of the technical force report direct. By this arrangement the geologists and field assistants have their entire time for the rather wide range of scientific, economic, and engineering work necessarily required of them, and economy is, it is believed, again subserved.

During the past year Messrs. Eveland and Smith, geologists, and Messrs. Goodman and Ickis, field assistants, have accomplished much and valuable work along the lines given above, including preparation of reports upon field work in Rizal, Pangasinan, Lepanto, Benguet, and Masbate by Mr. Eveland, upon field work in Batan, Albay, and Batangas by Mr. Smith, upon field work in Bulacan by Mr. Goodman, and upon field work in Rizal, Laguna, Bulacan, and Bataan by Mr. Ickis, together with reports upon minor subjects assigned, and with investigations, reference, and research connected therewith.

In return for publications of this Bureau a number of valuable exchanges, comprising the most important journals relating to engineering, mining, metallurgy, and geology, are received. These publications are placed upon à large table in the main office of the Bureau and are at the disposal of all who may require their use. Complete sets of exchanges are eventually sent to the general scientific library for file. A double reading and correspondence desk is maintained in this room especially for the accommodation of visitors, and stationery and reference material are supplied for the purpose of taking notes. This "visitors' desk" has been much appreciated in the past.

During the past year, by direction of the honorable the Secretary of the Interior, a general scientific library was formed by consolidation of the technical and scientific libraries of the various Bureaus of the Department of the Interior and was placed with the library of the Bureau of Government Laboratories under the supervision of the Superintendent of that Bureau. From this Bureau were accordingly transferred a comparatively small number of books obtained by purchase and a large number of valuable publications received through exchange. In order that the volumes most often required by this Bureau might be at hand upon the working shelves the withdrawal of some of these books was authorized and they are now in this Bureau upon memorandum receipts. Experience since the transfer was made has led me to believe that this withdrawal under the present arrangement is essential to the most economic use of the volumes, and that it has so far been attended with satisfactory results. The obvious advantages of the consolidation of books into one scientific library for general use are (1) prevention of unnecessary duplication of books, (2) feasibility of compiling a general catalogue and keeping it to date, and (3) advantages of uniformity of methods in preservation, in purchase, and in exchange. By withdrawal upon the part of each Bureau concerned of those volumes required the remainder are provided and cared for in the most economic and systematic way.

In concluding this portion of my report it is my pleasure to record that to Mr. R. C. Redmayne, chief clerk and stenographer, especial credit should be given for his efficient work throughout the year. The entire correspondence of the Bureau for the past five years, the mailing addresses, catalogues, and other office material have been filed under the card-index system by Mr. Redmayne in addition to his regular work. His duties, including the charge of all correspondence, have been many and onerous, but he has always responded promptly to every demand upon his services and has proved himself an invaluable man to the Bureau.

All clerical work of this Bureau is under the direct charge of Mr. Redmayne, whose only assistant is Mr. G. M. de Ubago, record and property clerk. Mr de Ubago was first appointed to this Bureau on April 2, 1900, by my honored predecessor, now Judge Chas. H. Burritt of the Mountain District. Mr. de Ubago, a native of these Islands, has improved upon the training received under the Spanish Government, and upon that given him by Judge Burritt, and has shown himself a most loyal and efficient clerk. He has learned English, has become an expert typewriter, is a fair accountant, and a good interpreter; he is prompt to respond to demands upon him, is always at work, and always on time. A more satisfactory example of the possibilities of the native clerk, it is believed, would be difficult to find.

MUSEUM WORK: COLLECTION; PETROGRAPHIC, BLOWPIPE, AND PALEONTOLOGIC WORK; FIELD AND MEGASCOPIC CLASSIFICATION OF THE IGNEOUS ROCKS.

During the past year the rock and mineral collections of this Bureau have increased by additions of samples sent in by prospectors, miners, and others interested in mines, to whom this acknowledgment of cordial appreciation is due, and by suites of samples brought back by Bureau parties returning from the field.

Time has not yet been available for the recataloguing proposed of the collections by the card system, but it is planned to do this during the coming year. Opportunity will then be taken to thoroughly sort over the collections, dispensing with worthless material, storing duplicates for exchange, and rearranging the cases geographically apportioned to material not exhibited in the economic suites.

In connection with petrographic work Mr. Eveland, geologist, has been directed to systematically arrange and catalogue all rock slides for use under the microscope; and in the paleontologic work of classifying fossils collected, Mr. Smith, geologist, has been similarly directed to provide for and catalogue all fossil material gathered; and Mr. H. M. Ickis, field assistant, has been placed in general charge of the remaining collections, and credit for their present arrangement is due to him.

The petrographic determinations of rocks, a very important division of the Bureau work, has been placed under the general charge of Mr. A. J. Eveland, who is also charged with the greater portion of the economic geology of the igneous rocks. This Bureau is now equipped with a microscope and accessories of the best type, and, with this and his complete private petrographic library, Mr. Eveland has entered upon his highly interesting and profitable work with enthusiasm and zeal. Rock sections of samples collected by him in Benguet and Lepanto have been prepared and examined by Mr. Eveland, sections of igneous rocks from Batan Island and elsewhere have been studied by Mr. Smith, and sections of several samples requiring microscopic examination have been reported upon by Mr. Goodman during the past year. The field of investigation of the igneous rocks in the Philippines is wide and but slightly touched upon, and important results in petrographic work are expected. Future investigation of rocks under the microscope will also be made by Mr. Smith and Mr. Goodman as occasion demands.

Determinations of ores and minerals by the blowpipe have been made by Messrs. Smith, Goodman, and Ickis during the year and have continued to prove rapid, economic, and fairly reliable in securing information desired. A large proportion of samples sent to this Bureau can be readily classified by rapid blowpipe work at an insignificant cost. This work, most satisfactorily performed by men most closely associated with work in minerals, ores, and rocks, has been a valuable adjunct to this Bureau for the past five years.

Paleontologic work has been begun by Mr. Smith in the classification of fossils obtained by him in his investigations of the Batan Island coal field, and will be extended over all age determinations of Philippine rocks. This work, commonly considered purely scientific, is of the highest importance in the correlation of stratified deposits and determination of continuity of beds of economic value, particularly of coal, and it will form a material portion of the special work assigned to Mr. Smith. This field has been but little worked in the past, and it is hoped that valuable results will follow upon its investigation in connection with Bureau plans.

In the important matter of megascopic and field classification of rocks the greatest difficulties have presented themselves here, as elsewhere, in attempts to give a satisfactory proximate classification for the igneous rocks. Various authors, prominent among whom in American geological work are Prof. J. F. Kemp, of Columbia University, and Prof. E. H. Williams, of Lehigh University, have prepared handbooks for the identification of rocks without the microscope. In addition to these are the highly valuable writings of G. P. Merrill, of the Smithsonian Institution; J. S. Diller, of the United States Geological Survey, and the text-books on geology of Dana, Geikie, Prestwich, Le Conte, Scott, and finally of Chamberlain and Salisbury, in English, in which descriptions, largely available for use without the microscope, are given for the igneous rocks. Following upon the use of different systems of classifications, and upon a tendency only too frequent to propose new names, however, a multiplicity of rock names has grown up and a confusion of nomenclature has been the inevitable result. Modern efforts toward systematic treatment of, and a greater simplicity in, this matter have resulted finally in a proposed megascopic classification, by the joint efforts of the eminent American petrographers Whitman Cross, Joseph P. Iddings, Louis V.

Pirsson, and Henry S. Washington, as given in their Quantitative Classification of Igneous Rocks, published in Chicago in 1904. This classification is reproduced in the most recent text-book of geology, that by Chamberlain and Salisbury, of which volume 1 was issued in 1904, with slight modification, and it has been provisionally and officially adopted by the Chief of this Bureau, somewhat further simplified, as apparently best serving needs for field and megascopic use. It is considered that the Philippine field is so free from preconceived prejudices and opinions in this respect that the scheme adopted should work with least friction here; and it is hoped that the simplicity and elasticity of the classification will enable all miners, prospectors, teachers, or others interested in Philippine igneous rocks to apply the system with a minimum of difficulty and with a maximum of satisfactory results.

The classification above mentioned is fully given in the following special circular No. 1, dated March 10, 1905, which was published for general use in the Official Gazette of April 26, 1905:

To the geologists and field assistants, Mining Bureau:

The following system, for megascopic and field classification of the igneous rocks, as proposed by the eminent petrographers Messrs. Cross, Iddings, Pirsson, and Washington, added to with respect to the use of the word *dolerite* by Messrs. Chamberlain and Salisbury, of the University of Chicago, and modified for further simplicity by the Chief of this Bureau by the omission of all synonyms terminating in *-phyre,* with the exception of the two retained words *melaphyre* and *leucophyre,* is hereby provisionally adopted for official use in the work of the Mining Bureau. The letters (f. n.), signifying *field name,* will be invariably written after each word of this classification used unless a statement appears otherwise in a bulletin or report, reproducing the outline herewith adopted or to the effect that the system is used as authorized and directed herein.

Every effort will be made to explain and popularize this classification to the end that miners and others interested in the Bureau work may use terms in harmony therewith.

DIVISIONS OF IGNEOUS ROCKS.

A. *Phanerites* are rocks whose mineral components can be seen with the unaided eye.

B. *Aphanites* are rocks whose mineral components can partly be seen with the unaided eye, the remaining lithoidal material being not resolvable into its component parts.

C. *Glasses* are rocks with vitreous luster in the whole or a part of the mass.

DIVISION A—PHANERITES:

1. *Granites* (f. n.) are granular igneous rocks with dominant *quartz* and *feldspar* of any kind, with mica, hornblende, or other minerals in subordinate amount.
2. *Syenites* (f. n.) are granular igneous rocks with dominant *feldspars,* of any kind, with hornblende, pyroxene, mica, or other minerals, but with little or no quartz.
3. *Diorites* (f. n.) are granular igneous rocks with dominant *hornblende* and subordinate feldspar of any kind, with or without other minerals.
4. *Gabbros* (f. n.) are granular igneous rocks with dominant *pyroxene* and subordinate feldspar of any kind, with or without other minerals.

5. *Dolerites* (f. n.) are granular igneous rocks *with any dominant ferromagnesian mineral,* not megascopically determined, and subordinate feldspar of any kind, with or without other minerals.
6. *Peridotites* (f. n.) are granular igneous rocks composed of *olivine* and *ferromagnesian minerals,* with little or no feldspar or other minerals.
7. *Pyroxenites* (f. n.) are granular igneous rocks composed of *pyroxene* with little or no feldspar or other minerals.
8. *Hornblendites* (f. n.) are granular igneous rocks composed of *hornblende* with little or no feldspar or other minerals.

DIVISION B—APHANITES:

(*a*) Nonporphyritic. These are divided into—

1. *Felsites* (f. n.), or aphanitic igneous rocks, nonporphyritic and *light colored,* without vitreous luster.
2. *Basalts* (f. n.), or aphanitic igneous rocks, nonporphyritic and *dark colored.*

(*b*) Porphyritic. These *porphyries* are divided, depending upon the dominant phenocryst, into—

1. *Quartz-porphyry* (f. n.), composed of *quartz* phenocrysts and aphanitic matrix.
2. *Feldspar-porphyry* (f. n.), composed of *feldspar* phenocrysts and aphanitic matrix.
3. *Hornblende-porphyry* (f. n.), composed of *hornblende* phenocrysts and aphanitic matrix.
4. *Mica-porphyry* (f. n.), composed of *mica* phenocrysts and aphanitic matrix.
5. *Augite-porphyry* (f. n.), composed of *augite* phenocrysts and aphanitic matrix.
6. *Olivine-porphyry* (f. n.), composed of *olivine* phenocrysts and aphanitic matrix.

They are also divided, according to color, into *leucophyres* (f. n.), which include all *light-colored* porphyritic, aphanitic, igneous rocks, and *melaphyres* (f. n.), which include all *dark-colored* porphyritic, aphanitic, igneous rocks. Depending upon the phenocrysts again we have—

1. *Quartz-leucophyre* (f. n.), or *light*-colored *quartz-porphyry.*
2. *Feldspar-leucophyre* (f. n.), or *light*-colored *feldspar-porphyry.*
3. *Hornblende-leucophyre* (f. n.), or *light*-colored *hornblende-porphyry.*
4. *Quartz-melaphyre* (f. n.), or *dark*-colored *quartz-porphyry.*
5. *Feldspar-melaphyre* (f. n.), or *dark*-colored *feldspar-porphyry.*
6. *Hornblende-melaphyre* (f. n.), or *dark*-colored *hornblende-porphyry,* and so on, the second word indicating the *color,* and the first, the *phenocryst,* of the porphyry described.

DIVISION C—GLASSES:

1. *Obsidian* (f. n.) is *vitreous* rock of any color, usually black, often red, less often brown or green. When porphyritic this becomes *porphyritic-obsidian* (f. n.).
2. *Pitchstone* (f. n.) is a rock *resinous* in appearance, less lustrous than obsidian, and *lighter colored.* When porphritic this becomes *porphyritic-pitchstone* (f. n.).
3. *Perlite* (f. n.) is a *glassy* rock with *perlitic texture* produced by small spueriodal fractures. When porphyritic this becomes *porphyritic-perlite* (f. n.).
4. *Pumice* (f. n.) is a highly *vesicular glass, white* or very *light* colored. When porphyritic this becomes *porphyritic-pumice.*

REFERENCES.

Reference is suggested in connection with the above to the following:

1. Quantitative Classification of Igneous Rocks, by Whitman Cross, Joseph P. Iddings, Louis V. Pirsson, Henry S. Washington.
2. Geology, Vol. I. Geologic Processes and Their Results. By Thomas C. Chamberlain and Rollin D. Salisbury.

FIELD WORK.

During the fiscal year field work was performed in connection with investigation of mineral resources, and the securing of data for general information for reports and published bulletins, by members of the Bureau as follows:

(1) Completion of Lepanto work, Messrs. Eveland, Goodman, and Ickis, and Mr. Riendeau (temporary employee), July 1 to August 3, 1904.

(2) Exploratory work in Calamianes Islands, Mr. McCaskey, September 13 to 21, 1904.

(3) Field work and collecting in Bulacan, Mr. Ickis, October 25 to 29, 1904.

(4) Preliminary work in Masbate, Mr. Eveland, October 26 to November 4, 1904.

(5) Field work, Laguna and Rizal, Messrs. Eveland and Ickis, November 6 to 13, 1904.

(6) Exploratory work in Mindoro and adjacent islands, Mr. McCaskey, November 6 to 13, 1904.

(7) Field work, Lepanto and Benguet, Mr. Eveland, January 16 to February 14, 1905.

(8) Field work, Mariveles, Bataan, Messrs. McCaskey and Ickis, January 26 and 27, 1905.

(9) Field work, Laguna, Messrs. McCaskey and Ickis, February 2 to 19, 1905.

(10) Exploratory work, Romblon, Sibuyan, Mindanao, Camiguin, Siquijor, Negros, and Masbate, Mr. McCaskey, March 18 to 31, 1905.

(11) Field work, Pangasinan and Benguet, Mr. Eveland and Mr. Weber (temporary employee), March 11 to June 30, 1905.

(12) Field work, Batan Island and adjacent territory in Province of Albay, Mr. Smith, March 18 to May 15, 1905.

The above field work, performed at a cost to the Bureau of ₱2,513.40 for all field expenses, includes investigations of the geology and gold and copper deposits of Mancayan and Suyoc, in Lepanto, of the Antimok and Bued River districts of Benguet, and of Salasa, Pangasinan, of the gold deposits of Masbate and of building stone at Talim Island, Laguna de Bay, by Mr. Eveland; of the geology, coal, limestone, and volcanic areas of the Island of Batan and vicinity, by Mr. Smith; of the building stones and clays of Rizal and Laguna, the iron deposits of Angat, Bulacan, and the building stones of Mariveles, Bataan, by Mr. Ickis; and of the general geology and mineral resources of a number of points upon various islands visited by the Chief of this Bureau during the year.

Since the completion of the fiscal year 1905 and previous to the writing of this report, the Chief of this Bureau has visited the Islands of Banton, Romblon, Tablas, and Semirara; Mr. Goodman was in the field in the Angat iron region of Bulacan from August 8 to 13, and Mr. Smith investigated the copper deposits of the Loboo Mountains in Batangas Province between August 25 and September 6.

Future field work planned includes the completion of the investigations of the ore deposits of Benguet, Masbate, and Camarines Provinces, by Mr. Eveland; the completion of the study of the coal deposits of Batan, Albay, and Polillo, and the beginning of an extensive investigation of the coal and oil areas of Cebu, by Mr. Smith; the investigation of sulphur deposits and areas for the profitable working of placer gold by Mr. Goodman, and the continuation of his studies in limestone, building stones, and clays by Mr. Ickis, together with investigations of industrial conditions and of the mineral resources of Benguet, Masbate, the Camarines, and elsewhere by the Chief of this Bureau.

In addition to the above, it is planned that Mr. Smith begin a general investigation of the iron deposits of the Islands, make special visits to promising coal fields, and collect fossils for age determination of Philippine rocks; that Mr. Goodman secure general information in the field concerning the mineral resources and statistics, and that all members of the Bureau perform field work of a minor nature as occasion may demand.

The importance of available deposits of workable steaming coal is becoming constantly more marked, particularly in view of the prospective railway extension in these Islands, and since the recent highly successful experiments of the Bureau of Government Laboratories have demonstrated that satisfactory paper can be made from Philippine fibers, the importance of a reliable local supply of sulphur is also great.

The field work performed by members of this Bureau has been satisfactory in its execution and fruitful, it is believed, in important results.

Bulletins with maps, sketches, photographs, and analyses, upon the ore deposits of Lepanto and of Benguet, and a petrographic paper upon the rocks of these regions, by Mr. Eveland; upon the coal measures of Batan Island, and petrographic and paleontologic papers therewith, by Mr. Smith, and upon the clays of central Luzon, by Mr. Ickis, are now in preparation for the press, and material for a bulletin, with maps and photographs, upon the mineral resources of the Islands, is being gathered for publication at the earliest practicable time.

Special credit is due to Messrs. Eveland, Smith, Goodman, and Ickis for their loyal, active, and intelligent coöperation and for the excellent character of their work. They have demonstrated their value to the Bureau, have already broadened our knowledge of known mineral resources, have freely offered and rendered assistance in the field to those interested in the mineral industry, and have gathered and worked up new and valuable material above mentioned and now in course of preparation for published form and general use.

In concluding this portion of my report I respectfully invite your attention to Exhibits B and C, narrative reports, respectively, of field work, performed in compliance with my instructions, in Benguet and Pangasinan by Mr. Eveland, and in Batan by Mr. Smith, and to Exhibits D and E, special reports, made by my direction, as results of investigations of the Bulacan iron industry, together with conditions of market, labor, and transportation, and a design of a suggested improved blast furnace for Angat ores, by Mr. Goodman, and of the possibilities for building stone in the region of Laguna de Bay, by Mr. Ickis, respectively, the four reports constituting portions of the work of the staff of this Bureau during the past year.

SURVEYS AND MAPS OF THE PHILIPPINES.

The maps of the Philippines available at the present time are entirely inadequate to present and future needs. This is illustrated by the great lack of available topographic data for railway, waterway, highroad, and other surveys, not to mention requirements of topographic base maps for mineral, forestry, agricultural, and other industrial surveys of importance, and for geographic, geologic, ethnographic, and other scientific surveys of direct practical application and use. At the present time special topographic surveys must be made for each project carried out, upon scales suited to the special work involved, and therefore not necessarily in harmony with other scales used. This work is not by any means a total loss and is at present actually required, but it is not believed to be in accordance with highest cartographic or economic demands, for reasons herein outlined. A more serious state of affairs is found in the fact that no primary triangulation of the Islands is known to have been made from which a skeleton frame may be constructed and upon which secondary or tertiary triangulation maps and accompanying topographic data may be fitted as fast as secured. The result is that minor triangulations, with topographic maps of limited areas, now being made from field surveys absolutely required for present needs, will not necessarily fit together without adjustment that may be costly in the end.

The great need at the present time is therefore a primary geodetic triangulation of the Islands. This must be made, sooner or later, as a fixed basis for all future Philippine survey work of whatever kind. Following upon this, which could be made under the direction of the Bureau of Coast and Geodetic Survey as a logical and proper extension inland of its present excellent astronomic work, and at probably no very great additional cost, should be a secondary triangulation, similar in principle and execution, subdividing the skeleton frame into fixed areas of limited extent, which could then be covered by a bureau of topographic surveys composed in part of, and operating with, the Insular Bureaus involved. Great economy over present necessary conditions would, it is believed, thus inevitably result. These topographic surveys systematically executed over areas to be successively covered in proportion to their importance would then be portions of a well-regulated system giving proper and adequate control over all areas required. The public-land surveys, including surveys of mining claims, are in actual need of triangulated base maps, and without them serious trouble in connection with boundaries seems in store for future settlement. Surveys are now being made to satisfy actual present needs by the military and civil governments over various limited areas, for various purposes, all of them practical, and upon various scales. These surveys would be of greater final value, it is believed, were they executed upon the systematic plan suggested above.

In connection with the "Scientific Surveys" of the Philippines by the Federal Government and the plans of the committee as published and generally understood, it is respectfully suggested that the great need of these Islands at the present time, and in addition to the work now being carried on by Insular Bureaus composed of trained men already in the field, is a base map, as outlined above, upon which all maps of limited area may be fitted as parts of a systematic whole.

PHILIPPINE MINING AND MINERAL RESOURCES IN 1905.

The outlook for a profitable mineral industry is more hopeful to-day than it has been at any time since the American occupation. An increasing interest is being shown in mineral claims, and capital will probably be more readily obtained in the future than it has been in the past. It is believed that the law of the "survival of the fittest" has held good here, as elsewhere, and that the most promising mining claims we hear of to-day are many of them worthy of serious consideration.

Much activity in prospecting and development work was shown in several districts last year, modern machinery has begun to arrive from the United States, and more of it is understood to be ordered and expected at an early date.

Mining development, or prospecting, are now being carried on in the Provinces of Lepanto-Bontoc, Benguet, Pangasinan, Nueva Ecija, Bulacan, Rizal, Batangas, Tayabas, Camarines, Albay, Masbate, Cebu, and Mindanao.

In Lepanto, in the copper district of Mancayan, about forty claims, including the Santa Barbara and Sin Nombre pertenencias of the Spanish régime, all now located under the present mining laws, have been reported as having been secured as an option by agents of a New York syndicate and an expert is understood to be expected from New York to examine these properties in October of this year. The old Spanish workings have uncovered large bodies of high-grade copper ore on the Santa Barbara and Sin Nombre claims, and it is anticipated that much systematic exploration work will be done upon the adjoining properties upon the arrival of the syndicate engineer. In Suyoc, just south of Mancayan, some important prospects are being developed by American miners at the present time. Gold and copper ores both occur here. Analyses by the Bureau of Government Laboratories show four samples of Mancayan ores, collected by Mr. A. J. Eveland, geologist, Mining Bureau, to contain, respectively, 13.93, 16.5, 9.7, and 32.9 per cent in copper, and $4.75, $3.31, $1.65, and $0.85 to the ton in gold. The ores are "gray copper" ores, chiefly tetrahedrite, tennantite, enargite, and luzonite.

The Mancayan-Suyoc area was studied in 1904 by a field party from the Mining Bureau, consisting of Mr. A. J. Eveland, geologist in charge, Messrs. Maurice Goodman and H. M. Ickis, field assistants, and field employees engaged for the work. The report of Mr. Eveland, covering the work of a geological reconnoissance, as more detailed work was not advisable in the absence of topographic base maps and extensive development work, will contain maps, photographs, and analyses of rocks and ores, and will be a welcome addition to the literature of the economic geology of the Philippines; this has been completed, and is now in press as Bulletin No. 4.

In Benguet some important development work has been done, particularly in the district of Antimok. Here lie the claims of Messrs. Clark, Petersen, Clyde, Lehlbach, Reavis, and others, most of whom have been at work here for several years. Although the ore bodies have not yet been subjected to the detailed investigation they deserve, this work will be taken up immediately by Mr. A. J. Eveland, geologist, Mining Bureau, who has just completed topographic mapping and other preliminary work in this district. The ore bodies are apparently very extensive and it is known that much of the ore is of a good grade, varying through the district from $5 to $50 per ton in gold, the most important pay streaks being worked averaging over $12 per ton. Many samples from tunnels and crosscuts, however, indicate such constant low-grade values also that mine sampling in Benguet, as elsewhere, should be conducted with great care, and in accordance with most modern practice, in estimating values of ore in the mass. This is particularly advisable in view of the fact that similar samples, similarly taken in the same workings, show variations from $1.65 to $43 per ton, as in one vein, in which the pay streak gives the latter values and the next 4 feet assayed only $1.65. This is an oxidized ore in a quartz gangue as far as uncovered. According to Mr. Lehlbach, who has persistently pushed development work, the vein systems of this district are closely related and are, above water level, largely of free milling ores. Messrs. Kelly, Clark, Petersen, Reavis, and Clyde have done sufficient work upon their claims to prove deposits worthy of serious consideration and the amount of ore to be probably large. Mr. Clark has just received a three-stamp quadruple-discharge Hendy mill and a 60-ton cyanide plant, all in charge of Mr. C. M. Eye, mining engineer. Messrs. Petersen and Clyde have built in Manila shops a three-stamp mill for development purposes, and reports from Mr. Eveland indicate that they have had some satisfactory trial runs.

In the Bued River district Messrs. Hanson and Meade have uncovered a gold-copper lead upon which a three-stamp mill will be erected at once. This mill is now being built in Manila shops and will be used for development and for trial runs. The ore is refractory and apparently a concentrating and shipping ore, and, as the "Copper King" claim, upon which it occurs, is near the Benguet Road and enjoys excellent transportation facilities, it is planned that trial shipments of concentrates to the Tacoma smelter be made. In this connection it may be stated that in response to requests made by this Bureau for Philippine miners, the Tacoma smelter offers inviting terms to ore shippers here and has secured a rate per gross ton, f. o. b. Manila Bay, and delivered on smelter wharf at Tacoma, from the Boston Steamship Company, of $5 per ton.

In this district, also, Mr. Eveland reports that the ore outcrops on Mr. Petersen's "Gray Horse" claim are of lead, iron, copper, and zinc sulphides, carrying $20 to the ton in gold.

The three-stamp mill that Mr. Hartwell built in Manila and operated at a profit on his "Hope" claim in Benguet has temporarily closed down, owing to the death during the year of the man who made it a success. Mr. Hartwell was a miner of the best type, conservative, competent, and combining within himself the sturdy qualities of the pioneer with the intrinsic worth of high American citizenship. His loss is not only a loss to the mining industry here but to the large number of stanch friends he so readily made and kept. Mr. Hartwell was Kipling's "Explorer" personified and whatever tribute may be found within those noble lines he richly deserves. He blazed the trail, explored the hills, found the gold, built the first American stamp mill in the Philippines, transported it to Benguet, worked his mine and mill and made them pay—all against constant obstacles that would mean failure to a man of less energy and grit. His reward was his successful struggle with difficulties that none but his kind can understand; his monument will be the gold-milling industry of Benguet.

In Pangasinan in the foothills of the northern Zambales range, near Salasa, a number of claims have been recorded and worked. The ores here are copper carbonates and sulphides, assays of three samples from the claims of Mr. W. H. Miller, who is the pioneer in this field, showing respectively, 19.9, 11, and 18 per cent in copper, 13.2, 0.0, and 2 ounces in silver, and $2.76, $1.60, and $3.80 in gold. These claims are favorably situated with respect to transportation by water and by rail, and if development proves these deposits extensive the prospects should seem good for profitable working.

In Nueva Ecija, near Gapan and Peñaranda, on the Rio Chico and elsewhere, extensive deposits of placer gold have been known for many years. No veins are yet reported, but prospecting in the placer ground is being actively prosecuted at the present time.

In Bulacan, in the mountains east of the towns of San Miguel and Angat, important deposits of rich hematite and magnetite iron ores have been known, and worked by natives in a small way, for over a century. Analyses of these ores have shown many of them to be very pure, and some of them fully up to Bessemer grade. Samples of them have been sent by the Mining Bureau to the steel works of Lewis & Hazlett, of Wheeling, W. Va., for analysis and report, and correspondence is now in progress with iron works of Japan looking to the profitable shipment of these ores. Analyses made by the Bureau of Government Laboratories for the Mining Bureau and published in Bulletin No. 3 of this Bureau—A Geological Reconnoissance of the Iron Region of Angat, Bulacan—gave the following results:

Bulacan iron ores.	No. 1, hematite.	No. 4, magnetite.	No. 5 B, hematite.
	Per cent.	*Per cent.*	*Per cent.*
FeO	1.9	32.3	2.6
Fe_2O_3	88.2	48.7	84.2
CaO	.1	Trace.	.3
MgO	.2	1.3	.1
Al_2O_3	6.5	15.3	8.7
FeS_2	----------	Trace.	Trace.
CO_2	----------	Trace.	Trace.
H_2O	.1	.1	.3
SiO_2	2.2	2.2	3.8
P_2O_5	Trace.	.1	Trace.
TiO_2	.8	.1	Trace.
Total	100	100.1	100

The natives of Bulacan have worked these iron ores in the open entirely and have smelted them in their small clay furnaces, with charcoal as fuel. No flux has ever been used, although vast quantities of limestone are at hand. Excellent gray iron castings have been made for plow points and shares, and the usefulness and economy of these deposits are apparently capable of far greater attention and profit than they receive at the present time.

For additional and recent information concerning the Angat iron region of Bulacan, attention is respectfully invited to Exhibit D, above referred to, and accompanying this report.

In Rizal Province placer washing for gold has been carried on by the natives for many years, and this has led American prospectors to the search for the origin of the gold in the hills. No important discoveries have as yet been made, however, other than the discovery of platinum, first identified in small amount by this Bureau in placer sands from Rizal during the past year. In Rizal Province, also, in the vicinity of Bosoboso, there are coal and iron deposits which deserve more attention than they have yet had. At Binangonan occurs a limestone, fossilferous in part (the "nummulitic" limestone of Baron von Richthofen),[1] which has recently been examined with reference to its use in the manufacture of Portland cement. An analysis of a sample of this limestone, collected by Mr. H. M. Ickis, field assistant, Mining Bureau, made by the Bureau of Government Laboratories for this Bureau, gave the following results:

Binangonan limestone.

	Per cent.
Water at 110°	0.16
Loss on ignition	43.15
SiO_2	1.12
Al_2O_3	.08
Fe_2O_3	.07
FeO	.06
CaO	53.78
MgO	1.19
K_2O	.28
Na_2O	.49
Total	100.38
Specific gravity	3.29

This is at once seen to be an excellent material for the purpose of making cement; and there is available clay in the vicinity and good water transportation to Manila. Capitalists are now giving this proposition careful consideration with a view to erecting a modern rotary plant to cost not less than $225,000. There has been, and will be, a large demand for cement in the Philippines, and, with the vast quantities of limestone and clay known to occur in the Philippines, it would seem unfortunate if cement can not be made here, at a profit, and of standard grade.

In Batangas Province work has been done in the Loboo Mountains upon twenty-one claims containing copper ores, two surface samples of which assayed, respectively, 2.71 and 17.1 per cent in copper, with a trace of gold in each, and a third showing 10 per cent in copper and $8 in gold. Later samples have given much lower results than those above.

The veins are of two systems and of the fissure type, according to Mr. Smith, who has studied them, in dioritic rock (petrographically yet undetermined) and are from 6 inches to 2 feet wide, with an east-west strike for the major system and N. 45° to 57° W. for the second.

The principal minerals are bornite, chalcopyrite, tenorite, cuprite, chalcocite (?), malachite, and azurite. Traces of silver are carried by the copper, and one assay has shown the ore to carry $8 in gold to the ton. Molybdenite has been found scattered throughout some of the same veins in which copper occurs. The veins are principally of quartz, but porphyry and pegmatitic veins have been seen.

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[1] The fossil forms of this limestone have recently been shown by Mr. W. D. Smith, geologist of this Bureau, to be *Orbitoides*.—H. D. McCASKEY.

Up to the present time little more than assessment work has been done, but further development work will shortly be undertaken.

These properties are situated very advantageously for mining work, being about 600 feet above sea level and not more than 5 miles from a good harbor at Guinasepa on the east coast of Batangas Province. Timber and water in abundance are available.

In Tayabas Province a large number of coal and petroleum claims have been recorded during the past year, although it is not known that extensive development work has been done upon them. The Tayabas petroleum field lies on the eastern side of the peninsula, on the Ragay Gulf. It has been reported that analyses of the petroleum have shown it to be of superior quality. No wells have yet been driven to thoroughly prospect this field, so far as known.

In the Island of Polillo, off the Pacific coast, a large number of coal claims have recently been recorded. They cover a series of four seams, each apparently about 4 feet thick, outcropping with an approximate north-south strike and a westerly dip. The tonnage of available coal covered by the claims recorded is probably very great. No figures can be given, however, in advance of development work. There are no marked evidences of faulting or undue disturbance of strata, although folding undoubtedly occurs. Good harbor facilities are available and, upon the whole, these claims are considered worthy of serious consideration as affording a probable supply of workable steaming coal. Outcrop samples give the following analysis:

Polillo coal.

	Per cent.
Moisture	4.7
Volatile combustible matter	43.5
Fixed carbon	50.1
Ash	1.7
Sulphur	.28
Calorific value	6,897

These coals are under investigation at the present time.

In the Camarines Province the Spanish concessions upon the extensive gold deposits in the districts of Paracale and Mambulao have been largely relocated by American mining men under present laws and without friction with the former concessionaires, and some work has been done in the reopening of abandoned shafts and in preparation for future systematic development. The important ore bodies of this district are reported to be contact deposits between crystalline schists and diorite, and to be well defined so far as uncovered. The contact is reported as traced for 20 miles, and along this all mining in this field has been done. Two vein systems intersect each other through the district approximately at right angles, the enrichment at some intersections having been reported upon as developing exceedingly high values. The strike of the most marked vein outcrops varies between 5° to 40° east and the dip is reported to be southeast. The veins are reported to be 1 to 8 feet wide and the vein filling to be quartz. Deep mining will probably involve pumping expenses of no mean consideration, but it is understood that much valuable ore may be taken out before this expensive stage of mining is begun. It is fully believed that the deposits are worth the attention of competent mining engineers, retained by sufficient capital to work these mines; but, in the meantime, a preliminary step will be taken this year in a careful study of this field by the detail of Mr. Eveland, geologist, to the work of a reconnoissance and the preparation of a general report upon the ore bodies themselves, and possibly by the further detail of Mr. Maurice Goodman, field assistant, to a careful survey of the placer fields of the Paracale and Malaquit Rivers. Reported assays from this district have averaged $20.92 in gold to the ton for the "San Mauricio," a representative group of claims covering deposits of partially refractory ore, and this for a large amount of systematic sampling reported by five different mining engineers. Assays of the "Tumbaga," a free-milling gold-quartz vein upon which a ten-stamp mill will probably be erected in February of next year, have given exceedingly rich returns, but as the sampling has been less carefully done upon this vein it would serve no good purpose to quote values here. The ores are described as sulphides of iron, copper, lead, and zinc, complex auriferous smelting ores in part and in part suitable for milling and cyanidation or chlorination. The placers have yielded important amounts of gold in the past, some of the nuggets being unusually large. While it may be somewhat doubtful whether sufficient rich placer ground remains for panning or sluicing methods, recent samples of gravel from the river beds indicate that dredger work here would pay. The average of nineteen samples of gravel recently taken by Mr. Robert Lienau from the Malaguit River and examined by Mr. H. M. Ickis, field assistant, shows a value of 16 cents to the cubic yard. It is anticipated that, notwithstanding mistakes that may have been made in the rather extensive development of the presumably rich ore deposits of this district in the past, the gold ores of Paracale and Mambulao, together with the placer fields, are most decidedly to be reckoned with in future work.

In Albay Province, in Batan Island, Lieut. H. L. Wigmore, Corps of Engineers, United States Army, assisted by a detail of men, has been prosecuting an examination of the coal deposits for the military government by means of the diamond drill. Mr. W. D. Smith, geologist, Mining Bureau, has been detailed to work out the economic geology of this area as his first work on the Philippines coal measures, and has been in the field for the past three months. His preliminary report is now in the press. The quality of the best Batan coals, which are classified by Mr. Smith as bituminous coals of Tertiary age, is shown by chemical analysis, calorific tests, and practical experimental use in boilers, to be excellent, and apparently fully suitable for steaming use. The quantity of the coal is believed also to be important, as are favorable local conditions for handling and shipping. Further and deeper borings should be made in Batan, however, before extensive mining is begun, to determine the continuity of the seams. Analyses by the Bureau of Government Laboratories of some of these coals follow:

Batan coals.	No. 1.	No. 2.	No. 3.
	Per cent.	*Per cent.*	*Per cent.*
Moisture	6.62	9.54	6.08
Volatile combustible matter	38.68	41.56	40.36
Fixed carbon	54.42	44.86	51.24
Ash	1.28	4.05	2.32
Sulphur	.14	2.37	.40
Calorific value	----------	6,983	6,487

In Masbate, in the northern part of the island near the town of Aroroy, more or less work has been done upon sixty or more claims, principally of free-milling gold ores in quartz, and upon twenty or more gold placer claims on the Lanan and Guinabatan Rivers. Manganese and iron ores of high grade have also been found here, but little attention has been given them up to the present time. Upon claims of the Eastern Mining Company, Mr. A. Heise has just erected a five-stamp mill, purchased from the Union Iron Works of San Francisco, to handle the free-milling ores, and as a result of successive trial runs aggregating eleven and one-half days, during which an estimated supply of 100 tons was crushed, fine bullion to the value of $954.67 is reported to have been obtained. This would indicate the value of the ore to average a saving of $9.55 to the ton. Upon the quartz claims of the Cogran Mining Company, on the Lanan River, a considerable amount of development work, showing most favorable indications of large quantities of free-milling ore, has been done. A series of parallel veins in granite and serpentine, the relations of which are yet undetermined, are reported here with a secondary system of intersecting veins. Upon the "Queen of Sheba" claim of this district there is an estimated dump of 2,500 tons of free-milling ore valued at from $8 to $42 per ton, the result partly of recent extensive open-cut work, and the sinking of an inclined shaft on the footwall, and partly of ancient workings carried on in a primitive way. An arrastra, driven by carabao power, has been successfully at work here for several months past, and the erection of a modern stamp mill will probably follow during the present year. Upon four claims of the Aroroy district a ten-stamp mill, originally intended for Benguet, and now in the Islands, will be installed at once by the Philippine Gold Mining, Power, and Development Company, according to plans recently announced. Upon the placer ground of the Philippine Mining Company on the Lanan River, a Risdon dredge, which represents modern and thorough workmanship in every detail, has just been completed and launched. This dredge will handle 1,000 cubic yards of gravel per diem, the gravel running, according to the estimates of Mr. Fred L. H. Kimball, consulting and managing mining engineer in charge, 25 cents and over to the yard. As the dredge should work for a total cost of less than 9 cents a yard, a good profit would seem to be in sight. Upon the placer claims of the Masbate and Oriental Mining Company, on the Guinabatan River, a similar Risdon dredge, just arrived from the United States in charge of Mr. H. J. Robinson, will it is hoped be immediately installed. The Aroroy and Lanan mining districts of Masbate have been in most energetic and progressive hands but have attracted less attention thus far than they deserve.

In Cebu but little more than prospecting has been done during the American régime. There are important deposits of steaming coal in this island and two known deposits of lead ores. An analysis of coal from the promising coal measures of Carmen, containing four seams reported to be, respectively, 14, 13, 9, and 17 feet thick, will give an idea of the purity of the best Cebu coals:

Coal from Carmen, Cebu.

	Per cent.
Moisture	5
Volatile combustible matter	43.92
Fixed carbon	48.51
Ash	2.2
Sulphur	.37
Total	100

These bituminous coals are better than many American lignites mined, sold at a profit, and used with success upon railway and steamship lines in the United States, and they have been proved by practical tests in steamships in Philippine waters to do very well indeed. Furthermore, they should be put on the Manila market for $3.25 per ton and on the market at Cebu for $2.50 per ton, as against Japanese coal at approximately $5 and Australian coal at $6 per ton.

In Mindanao some development work has been done by a little group of American miners at Placer, Surigao Province, but no late reports from this district are at hand. Some prospecting has also been done in Mindanao, and it is known that there is coal at Bislig and Sibuguey, and placer gold on the Agusan River and at Pigtao, near Misamis. This vast island is geologically yet unexplored.

Recent reliable reports are to the effect that asbestos has been found in quantity in Ilocos Norte; that metallic mercury has been found in Masbate, in the Camarines, in Zambales, and in Mindoro on the east coast; that manganese deposits are cut by the Capas-O'Donnell road; that tin and tungsten have been found in northwestern Negros, that infusorial earth occurs in Zambales and probably in Abra; and Mr. Smith has just reported the discovery by him of molybdenite ores in veins in the Loboo Mountains of Batangas Province.

In addition to the above mineral deposits that have received some active attention or have just been reported or discovered, gold, platinum, copper, lead, zinc, manganese, iron, antimony, mercury, coal, sulphur, petroleum, salt, gypsum, limestone, clays, and building stones are known to occur in the Philippines as mentioned in the Fifth Annual Report of this Bureau and as indicated upon the general mineral map of the Islands published with that report and reproduced herewith. A forthcoming bulletin of the Bureau presenting the latest and most complete information concerning the mineral industry, statistics, and resources of these Islands will be issued, it is hoped, during the coming year.

No more than investigation and development work have yet been done, and there are as yet no Philippine mines as the word "mine" is properly understood. In fact, there is little "ore in sight" in the sense that it is blocked out, but the indications are in many cases distinctly encouraging to more extensive work.

Although the matter of transportation is not yet satisfactory and must necessarily remain a factor of great cost until the promised and prospective improvements of coastwise shipping and rates, of extensive railway construction, and, above all, of a greater mileage of good wagon roads of moderate grade, may have materialized, the labor problem has not yet interfered seriously with mining development nor is it expected to prove a factor of great uncertainty or cost. My favorable views, expressed in the Fifth Annual Report, concerning the possibility of developing sufficient and satisfactory mining labor in the Philippines, of Japanese and natives, or of natives alone, under competent white supervision, remain unchanged. I further believe this labor to be counted upon to afford mining at a comparatively low cost and therefore to render profitable comparatively low-grade ores. Mining costs in the Philippines have so far been relatively low, and native labor has been almost exclusively employed. I am informed by Mr. Lehlbach, who has employed Japanese and native labor in Benguet, that he estimates that his total mining costs will be $0.70, his crushing, sorting, and tramming $0.24, and his milling and cyanidation $0.89, per ton, United States currency, on a basis of treating 4,000 tons of ore per month, and the above costs to be reduced to $0.49, $017, and $0.59 per ton, respectively, on a basis of 15,000 tons per month, this with native labor utilized under white foremen. These figures give totals of $1.84 and $1.25 per ton, respectively, but it is yet an open question whether costs so low can be maintained. Certainly they do not include pumping or hoisting from depth. In the Camarines Province it has been estimated that the total cost of mining, milling, concentrating, and management would be excessive at $5 per ton. In Masbate Mr. Heise reports that the total cost of mining, milling, fuel, and management, with native labor, has averaged $3.75½ per ton. The above are all gold-mining, stamp-milling, and development costs. In coal mining it has been estimated that at Carmen, in Cebu, the total cost of mining should not exceed $1 per ton. In Batan

Island, according to Mr. Smith, with Japanese labor, total mining costs have been $2 to $2.50 per ton. Lieutenant Wigmore estimates, however, that with Japanese and native labor mixed, and working on a commercial scale, total mining and loading costs should not exceed $2 per ton. The above costs, it must be demembered, are during the pioneer stage of development and adjustment to new conditions; it is expected that they will be reduced in time, with the exception of Mr. Lehlbach's estimates. At least two mining men doing development work have stated to me that their preference is for native labor over Japanese, and the tendency is for the native to step into his proper place in Philippine mining and furnish the bulk of the labor required. It is not contended for a moment that native labor in general has been entirely satisfactory in the Philippines during the past few years, but it is contended very strongly that for this unfortunate condition of things, particularly with reference to agricultural labor, the laborer has been by no means entirely to blame; and with special reference to a relatively new field, such as mining, it is believed that with the absolute essentials of (1) fair treatment, including reasonable wages and prompt payment, and (2) competent supervision, a sufficient and satisfactory quality of native labor may be depended upon.

On the whole, therefore, the mineral industry of the Philippines has steadily grown. What its future may hold can not be safely prophesied now; but with the Islands at peace and under a safe and stable government, with no more of a labor problem than it is believed can be overcome, with increased transportation facilities in sight, with more confidence on the part of capital, and a better showing on the part of prospecting and development work, a conservative estimate would indicate a bright outlook for the coming year 1906. It is hoped and believed that the sturdy pioneers who have blazed the trail through many a heart-breaking day in fever swamp, jungle, and forest, during years of peril and privation, the full tale of which will never be told, will yet come into their own, and through them that the mineral industry of the Philippines will prove an important factor in the development of prosperity and progress under American rule.

MINING LAWS, URGENT NEED OF MODIFICATION.

I have the honor to invite your attention to certain sections and provisions of the act of Congress approved July 1, 1902, entitled "An act temporarily to provide for the administration of the affairs of civil government in the Philippine Islands, and for other purposes." These sections and provisions constitute portions of the mining legislation at present in force in these Islands, and, by reason of their restrictions, have been subjected to constant complaint and frequent request for their repeal or modification by interests proposing and attempting the difficult work of development of the mineral resources of the Philippines.

The sections and provisions of the above-mentioned act that have been most severely and frequently criticized are as follows:

Section 33 (entire).—This reads as follows: "That no holder shall be entitled to hold in his, its, or their own name, or in the name of any other person, corporation, or association, more than one mineral claim on the same vein or lode."

Section 56 (pertaining to coal lands), the last two provisions: "* * * and all persons claiming under section fifty-eight shall be required to prove their respective rights and pay for the lands filed upon within one year from the time prescribed for filing their respective claims; and upon failure to file the proper notice or to pay for the land within the required period, the same shall be subject to entry by any other qualified applicant."

Section 75 (pertaining to corporations), the following provisions: "* * *; and it shall be unlawful for any member of a corporation engaged in agriculture or mining and for any corporation organized for any purpose except irrigation to be in any wise interested in any other corporation engaged in agriculture or in mining."

The discussion of these sections and provisions will now be undertaken from the standpoint of my connection of over five years with the Mining Bureau and the development of the mineral resources of these Islands, of my observations for nearly three years upon the working of these provisions and particularly of section 33, of the complaints and appeals constantly made by prospectors, miners, and others interested in our mineral resources, concerning the application of these severe restrictions under present and local conditions, and finally of some serious study upon my part during these periods concerning these conditions to be dealt with, and the advisability of more liberal legislation at the present time.

SECTION 33.

It has been understood that the Congress of the United States, in its wisdom, provided this section for protection of the natives of these Islands as against exploitation on the part of Americans, or others, "at the expense of the Filipinos," and that for this purpose alone this restrictive measure was deemed necessary at the time—that is, in July, 1902.

It has been a matter of common observation, I believe I may safely state, in these Islands during the past three years, that no undue or improper efforts have been made, that might have been prevented by section 33, by Americans or others to exploit mineral lands at the expense of the Filipinos. In other words, it has never clearly appeared that natives of these Islands would have suffered injury or loss through the operation of the present mining laws, with section 33 omitted entire.

On the other hand, the great difficulties of geological exploration and field prospecting, due to the excessive obstacles imposed by the luxuriant forest and jungle growth of the Tropics, and by the excessive thickness of soil overlying rock formations; of the present limitations in number of intelligent prospectors and miners; of the great distance from the United States wherein would naturally lie the greater portion of the previous associations and support of this prospecting class; of the consequent difficulty of securing capital; and of the somewhat uncertain political future of these Islands—these difficulties and others have combined to check mineral exploration and development, and the result is that large portions of the Islands have not been covered by prospectors even to the present day. It will therefore be seen that there has been no tendency shown as yet to overdo prospecting in the Philippines nor has capital in any important amount interested itself in this necessary preliminary work. The Filipinos as a race have not been made to suffer during the prospecting and locating already done and the few cases of claim jumping, common to every mining camp, have been irrespective of race. Finally, whatever contests concerning mining lands have been argued in the courts have been impartially and judicially acted upon.

The purpose and intent of the Congress of the United States, as exhibited throughout the act of July 1, above quoted, were plainly to protect the people of these Islands against monopolies, corporation rule, and unfair and dishonest acquisition of the public lands, mineral and otherwise. This expression of fair dealing to a people, conquered or acquired, has been followed by the honorable the Philippine Commission as well as by the Administrations and the Congress of the United States, in spirit and in letter throughout all the formative and constructional work performed in connection with the American occupation of these Islands during the past five years. This principle of protection of the rights of the Filipinos meets with the hearty approval, and wins the active support, it is believed, of all right-thinking Americans; and it is not believed that there is any tendency, either in the Philippines or elsewhere, to exploit these Islands *at the expense of the Filipinos* which can not be met and as completely checked as is possible by legislation, by the honorable the Philippine Commission or by the Philippine Assembly to be elected within a few years. It is believed that it can be shown, furthermore, that with the delegation of the interests of the natives of these Islands to the legislative powers at present representing the United States in the Philippines, there is no present necessity for the continuance of the restrictions of section 33, and that, rather, there is grave danger during such continuance that the mineral resources of these Islands will not be developed at all—this at the real expense of the Filipinos, to whom the greatest ultimate advantages must come by the development of what latent mineral wealth may here be found.

In July of 1902 there was no court of record provided to pass upon and settle disputes arising over titles to lands, mineral and otherwise, and, at that time, following upon the years of Spanish rule, there were found large and valuable portions of public lands claimed under various laws, provisions, and customs, by Spaniards, natives, and others, with titles more or less imperfect, inchoate, or completely void. At that time, and without legislative and judicial protection, particularly for mining claims, such as was urged by my predecessor, the present Hon. Charles H. Burritt, judge of the Court of First Instance, the rights of natives and others to land occupied in good faith by them were in many cases necessarily without legal support. Since the passage of the act of Congress above frequently referred to, however, and on November 6, 1902, the honorable the Philippine Commission created a Court of Land Registration with complete power to pass upon land claims and to grant to natives and others, under the admirable Torrens system, the most complete protection for their rights. Since that time, also, capital from the United States and elsewhere has been freely invited to develop the system of rapid transportation now successfully completed in Manila, a complete and modern telephone system for Manila and elsewhere, and a thoroughly modern and effective railway system for the entire Archipelago. Not only have the honorable the Commission been empowered to invite bids for development of the city of Manila and of the Islands along these lines but they have also been authorized to encourage single bids, or operations of single corporations constituting practically monopolies, for the purposes above set forth. It is pretty generally agreed that it is the part of wisdom for them thus to act. In view of the above statement it is difficult to understand that a corporation or other consolidation of interests, or several of them, in a given mineral district might not safely be encouraged under such regulations and restrictions as the honorable the Philippine Commission may in its wisdom deem just. It is not, therefore, believed that the operation of section 33 is at present required upon the ground that it is necessary for protection of the best interests of the natives of the Philippines. Upon the other hand, it is the opinion, I think I am justified in saying, of the mining community and the Government alike that the further operation of this section will be at a loss not only to the American citizens, who have been the potent factors in development in the Philippines, but also to the natives, who suffer precisely the same disadvantages as the Americans from the provisions of section 33, and who can profit no more therefrom.

As the necessity for protection of native rights provided for in section 33 does not now arise and as the honorable Philippine Commission have been charged, and have for five years exercised their most deliberate thought and greatest wisdom in their legislation for the protection of native rights, as the natives have now the desired means for securing full and final recognition of land claims of whatever class through the Court of Land Registration, and as there has never been, apparently, but the one motive above assumed for the enactment of section 33, it is respectfully submitted that this section may safely be repealed, thereby delegating to the honorable the Philippine Commission, who are in thorough touch with local conditions and demands, under sections 36, 49, and 52 of the act above quoted, the increased power following such repeal, to restrict appropriation of public lands.

Following an affirmative reply to the question, "May section 33 safely be repealed?" there arises the further question, "*Should* this section be repealed?" It has been the unanimous opinion of natives, foreigners, and Americans, official and otherwise, so far as I have heard opinion expressed upon this subject since the present mining legislation has been in force, that section 33 *should* be repealed. The reasons for this are not far to seek.

In section 21 of the act of July 1, 1902, the right to explore, occupy, and purchase mineral public lands is restricted to "citizens of the United States or of said Islands." The most secure and profitable investment of capital in mineral deposits not patented in the Philippines would be that apparently coincident with rights to explore, occupy, and purchase. Up to the present time, during American occupation, foreign capital has shown almost no disposition to enter upon development of mineral claims, nor has such capital been encouraged so to enter, by legislation or otherwise; up to the present time, also, native capital has proved insufficient for the development of even a reasonable proportion of the agricultural resources, except in a most primitive way. It is therefore plainly evident that the capital absolutely essential to the development of the mineral resources of these Islands in a thorough and profitable manner must, under American sovereignty, be expected to come from citizens of the United States. The distance to and from the United States is so great that close contact or communication, on the part of capital there with possible fields of investment here, is only possible by representation through agencies in the Philippines, and in the case of mineral resources these agents would naturally be consulting mining engineers, metallurgists, or geologists, as the case may be. The expense of retaining professional men of this class, even to report upon mineral fields, is so great that it can only be considered under most favorable conditions; yet capital at the present time is dependent upon its consulting engineers as it is upon its attorneys, and properly so. It is reasonable to assume that no minor representative of capital, still less a consulting engineer, would visit the Philippines for the purpose of investigating and reporting upon the value of any *one* unpatented claim, 1,000 feet square, upon any one lode, or several such claims upon as many lodes; and yet no one person, corporation, or association could offer more that is unpatented under the law. It is obviously objectionable for capital to deal, or attempt to deal, with as many persons, corporations, or associations, as it may desire claims; only under exceptional geological conditions could systematic mining methods be followed under such prohibitive conditions as these. It is difficult at present, therefore, to induce capital in the United States even to consider mining in the Philippines. But it requires capital to develop and patent claims; and it is with the unpatented that we are chiefly concerned. It would seem apparent from the above line of thought that capital from the United States will not become interested in unpatented claims under section 33, and that unpatented claims can not, therefore, be developed into mines. Exception to this might possibly lie in the case of *bonanza* or exceedingly rich claims; but it is probably unnecessary to add that *bonanzas* are relatively few—certainly they have not yet been discovered in the Philippines, where the richest gold ores have averaged in value from $2 to $50 to the ton. The great majority of the mines of the world are concerned with middle and low grade ores, and Philippine conditions are like those of other mining regions in this respect. The greatest skill and professional ability of the modern mining engineer and metallurgist are dedicated to-day to technical improvements by which costs may be reduced, and deposits of lower grade may therefore be made profitable to work. An essential to reduction of cost is the opportunity to consolidate claims and work upon a large scale. This is vital with low-grade ores. The problem is largely, therefore, one of *cost,* an economic feature even more severe in mining and in metallurgy than in ordinary business or governmental administration, for the reason that in reduction of cost the most expensive professional advice is required, and the natural obstacles are complex and difficult to the highest degree.

In the Philippines the ores are of middle and low grade, and economic problems enter from the first. In addition to this, problems of difficult tropic conditions, labor, transportation, and supplies, must be met, once capital is secured. The topographic, climatic, and geologic features of the Philippines render prospecting exceptionally difficult, and to these and to other unfavorable conditions may be ascribed the lamentable fact that, notwithstanding an occupancy of several hundred years, our Spanish and native predecessors succeeded in developing no mines worthy of the name. Resulting from this, the natives of these Islands are neither intelligent prospectors nor miners in the modern sense, and with the exception of a limited number of Igorots, Bicols, and others, they do not know even primitive mining. There is, therefore, no important mining community among the Filipinos, and the interests of mining development are at present largely in the hands of a small number of American miners and prospectors. Were these men to leave the Islands, as many of them have done, the mineral resources would undoubtedly lie undeveloped for an indefinite number of years, as there is no mining class among the natives yet bred to take up their work. The future of the mineral industry is believed, therefore, for the present to be dependent upon these hardy, intelligent, and invincible American pioneers, who have laboriously blazed the trail, as they and their forbears developed our West. They have penetrated the wilderness and have in five years developed and opened up several promising mining districts that were little known and less developed during all the centuries before they came. They have overcome, and it is believed can overcome, every important obstacle save a lack of sufficient capital to proceed with their work. For several years they have drawn upon their own limited resources and those of their friends in the Philippines; they have now reached that point when capital upon a larger scale is practically an essential to success. They have developed mineral districts, but their finds have largely been in middle-grade and low-grade ores. The problem of cost of mining and cost of production is a vital factor in their relations with capital, and it is therefore necessary that they be able to offer more, to guarantee the further development required to justify erection of works, than section 33 will allow. Extensive deposits of the above class of ores are believed to exist in the Philippines, and after five years of work in these Islands I am prepared to express my belief that an important and profitable mining industry *can* be built up here with proper encouragement, and this with no menace whatever to the rights of the natives, but rather to their material advantage in all that development and industrial progress must necessarily mean to them.

In their annual reports for 1903 and 1904, the Chiefs of the Mining Bureau, the honorable the Secretary of the Interior, and the honorable the Philippine Commission have recommended the repeal of section 33. It is respectfully submitted that this action is now of vital importance to the mining interests of these Islands, that it can be safely taken, and that it should be taken at the earliest practicable time.

SECTION 56.

The provision within this section deemed hostile to early development of coal lands is as given above.

It should be stated here that, *literally construed,* this provision offers no objection whatever for the reason that section 58 quoted in this provision refers to saline lands alone; and in Lindley on Mines, page 1683, this construction is evidently made, as the subject brief of this clause reads: "Saline claimants, when must pay." As sections 53, 54, 56, and 57 constituting the legislation embraced within the act of July 1, 1902, for coal lands, are almost literally the United States Revised Statutes, 2347, 2348, 2349, 2350, and 2351, constituting the present legislation for coal lands in the United States, and as the corresponding restricting clause in United States Revised Statutes, 2350, refers to coal lands mentioned in United States Revised Statutes, 2348, it is assumed that by taking advantage of an apparent typographical error alone in section 56 can the construction be that the lands referred to are the saline lands of section 58, and not the coal lands of section 53, which section corresponds to United States Revised Statutes, 2348. The interpretation upon which the following is based is that accepted as the undoubted intent, though not literally expressed or legally binding perhaps, of the law as framed.

Although this provision is in terms the direct adaptation to the Philippines of a Federal provision now in force concerning coal lands in the

United States (Rev. Stats., 2350), it is believed that under Philippine conditions a prescribed period of one year and sixty days is too limited a time within which coal claims must be entered upon, recorded, sufficiently developed to demonstrate their value, and *paid for in full.* Geologic problems upon which values of coal lands depend have not yet been satisfactorily solved, and all difficulties relating to capital, as discussed under section 33, apply in this case. Furthermore, the payment for lode claims is extended over a period of five years or until such time as accrued assessment work to the value of $500 may have been done upon each lode claim or until the locator thereof desires to obtain a patent therefor by purchase at a fixed rate of $5 per acre. A locator of a lode is thus given sufficient time within which to prove the value of his claim, whereas the locator of a coal-land claim must be satisfied within one year and sixty days after occupation of his claim that he is prepared to pay the prescribed price in full. This involves the expenditure of large amounts of capital for development, surveys and title within so short a period that under present conditions it is practically prohibitive.

It is respectfully submitted that the coal-land laws be revised to the extent that the period for development and payment be extended to at least three years, or until such time as the public lands involved may have been surveyed and mapped under a system of public-land surveys, in harmony with United States Revised Statutes, 2349, and the practice in the United States (Lindley on Mines, Vol. I, sec. 505), said revision delegating to the honorable the Philippine Commission such powers as may be required to encourage *bona fide* coal mining and to prohibit mere speculation in land or monopolistic control.

The coal resources of the Philippines are believed to be extensive and to promise an important supply of steaming coal. The economic features and importance of a home supply are so obvious that they will not be enlarged upon here. The local conditions above referred to are such, however, that it is believed a coal-mining industry must be encouraged by more liberal legislation than at present obtains.

SECTION 75.

The provisions of this section, quoted before, considered inimical to mining development, will in effect so circumscribe corporations as largely to discourage their interest in mining in any form. Furthermore, interests connected with corporation capital "organized for any purpose except irrigation" are prohibited from investing in either agricultural or mining projects which corporations may control.

These prohibitions are particularly severe in view of the fact that a large number of the best and most substantial capitalists are largely involved in corporate interests and that with these profitable and promising mining companies are closely allied as well. Were the interests of the natives or the general public menaced by corporation control or fraud the honorable

Philippine Commission, it is believed, or the Philippine Assembly, would, by such legislative restriction as may be required, extend to them all protection demanded under such conditions as may arise. This has even now been accomplished in the form of corporation capital invested in rapid transportation within the city of Manila, and of proposed corporation investment in modern telephone and railway development here.

It is respectfully submitted that the corporate interests, being largely the capital interests, should be encouraged under such protective legislation as the honorable the Philippine Commission may provide, to assist in the development both of agricultural and of mineral lands. It is believed that this may safely be done without such prohibitive enactment as that above quoted in section 75; and considerations presented under the discussion of section 33 are submitted as bearing upon the operation of the restrictive clause of section 75 as well.

ADDITIONAL LEGISLATIVE DEFECTS.

In addition to the considerations above, and in connection with the proposed draft of an act amending the act of July 1, 1902, I desire to call your attention to additional important considerations as follows:

ASSESSMENT WORK.

(*a*) Should the time within which coal lands must be paid for be extended to three years, as urged above, it would seem advisible to require some assessment work corresponding to that upon lode claims and for the same reasons—i. e., to prevent the holding of tracts of land for speculative purposes alone. I would suggest, therefore, that a total of not more than $200 worth of assessment work for each coal claim held for three years be required before a patent be issued therefor.

(*b*) As the Philippine miners have frequently requested specific authority, such as is granted in the Federal law of the United States (see Lindley on Mines, p. 1167), to group assessment work for several claims in order that annual labor may be performed upon one of a group for the development of the whole, I would urge that a proviso be inserted in the proposed amended act to the effect "that where a group of two or more contiguous lode, coal, or placer mining claims are held in common the annual labor required by law for all in the group may be performed upon any one of them for the development of the group."

This, in my opinion, would be a most vital and valuable addition to the law.

DREDGING CLAIMS IN NAVIGABLE AND TIDAL WATERS.

In a recent letter to you upon this subject I invited attention to the important fact that after careful study I find there is at present no legislation, apparently, permitting the mining or dredging for gold or other metals in navigable and tidal waters of these Islands. As many navigable and tidal streams and bays of the Philippines are believed to contain deposits of these metals that may be profitably worked, and as two modern dredging plants are now in Philippine waters for this purpose, I strongly urge the enactment of legislation, based possibly upon the Alaska Code of 1900, whereby these waters may be declared subject to exploration and mining by virtue of licenses to be granted by the Governor-General and under such regulations as the Philippine Commission or their successors may provide.

VIEWS OF PHILIPPINE MINING MEN.

In this connection I would state that not only in personal conversation with mining men in the Philippines and in the United States, over a period of three years, have I been impressed with the unanimous conviction that present restrictions in Philippine mining legislation should be materially modified, if not absolutely repealed, but that upon the occasion of the recent visit to these Islands of the distinguished Congressional party accompanying the honorable the Secretary of War, this office has received a large number of letters, in response to a circular from this Bureau requesting an expression of views upon this subject, strongly advocating prompt repeal of the restrictions mentioned above. These letters are from representative miners, prospectors, business and professional men, and are unanimous in their appeal for better mining laws; and with their writers I heartily sympathize and agree.

CONCLUSION.

In conclusion, attention is respectfully called to the fact that as far back as 1849 President Fillmore, in his first message to Congress, recommended that the public mineral lands "* * * be divided into small parcels and sold, under such restriction as to quantity and time as will insure the best price and guard most effectively against combinations of capitalists to obtain monopolies" (Lindley on Mines, Vol. I, sec. 48), and that this was followed by the acts of July 26, 1866, and of July 9, 1870, which were in turn superseded by the act of May 10, 1872, now incorporated within the Revised Statutes and forming the present Federal mining legislation of the United States. In the first of these acts only may be found any provision limiting the number of claims that any one person, corporation, or association may hold upon any given vein or lode, and this was repealed in 1872 when it was not deemed essential apparently to the best interests of the public that such restriction be required. Not again until the act of July 1, 1902, herein frequently referred to, was such restriction placed within Federal legislation, and in this instance for the safeguarding of the rights of the Filipinos rather more than of those of the public at large. No such restriction is known to me in any mining legislation elsewhere, and its workings may therefore be said to have been observed in the Philippines alone.

That this, and other restrictions above noted, should be wholly removed or materially modified, in the best interests of the development of the resources, and through them of the people, of these Islands, I respectfully submit.

FINANCES OF THE BUREAU, FUTURE NEEDS.

For the expenses of this Bureau for the fiscal year just past the appropriations were ₱25,000 for salaries and wages and ₱6,100 for field and office expenses, a total of ₱31,100. Of this amount there were expended for salaries and wages ₱23,992.95, leaving a balance of ₱1,007.05, and for contingent expenses ₱5,988.30, leaving a balance of ₱111.70; the total balance to the credit of the Bureau for the year from unexpended funds is therefore ₱1,110.75.

For the coming fiscal year the estimated amount required for salaries and wages is ₱28,261.04 and for field and office expenses ₱13,207, a total of ₱41,468.04.

The increase in salaries and wages estimated, of ₱3,261.04, is made up of difference in salary of one geologist at ₱4,000 between the entire year 1906 and a portion of the year 1905, and increases in salary recommended of one field assistant from ₱2,400 to ₱3,600, and of one chief clerk from ₱2,800 to ₱3,200, for part of the year 1906, upon completion of two years of highly satisfactory service as mentioned above. The increase in contingent expenses estimated, of ₱7,107.00, is more than covered by estimated printing expenses for four publications of this Bureau and for forms, blank books, letter heads, etc., not estimated or provided for in 1905, amounting to ₱7,000; of postage and telegraphic expenses, in lieu of the free service of the past and therefore not estimated or provided for in 1905, amounting to ₱2,540, and of an increase of ₱400 in field expenses for the more extensive work of the coming year; in all, amounting to an apparent increase in contingent expenses of ₱9,940, of which ₱9,540 is an estimate due to required estimates for expenses not charged against this Bureau last year, thus showing a relative *decrease* in contingent appropriations of ₱2,833 for the fiscal year 1906, or a relative total increase of all appropriations over last year of but ₱828.04 for the coming fiscal year.

The just promotion of two especially loyal and efficient members of the Bureau staff, the necessity for the increased field work possible with the completely reorganized Bureau, and the demand for reliable published information upon the mineral resources of these Islands, it is believed, will fully justify the necessary increase of appropriations required. I can not urge too strongly that the severe economy which this Bureau has attempted to maintain in the past and proposes to maintain in the future may be considered in appropriation of funds for the coming year.

SUMMARY OF RECOMMENDATIONS.

In concluding this report I have the honor to recommend—

(1) That the status and organization of this Bureau be maintained as provided for in Act No. 916.

(2) That suitable quarters be provided for this Bureau by the construction and equipment of a new wing to the present building of the Bureau

of Government Laboratories, of which wing the entire upper floor is desired.

(3) That the Congress of the United States amend the present mining legislation as fully discussed above, delegating power to the honorable the United States Philippine Commission, or the Philippine Assembly, to enact all laws required, if any, to prevent undue exploitation of the public lands.

(4) That appropriations requested in estimate of funds required for the fiscal year 1906 be made that this Bureau may be enabled to fully perform its proper functions as authorized in Act No. 916.

Respectfully submitted.

H. D. McCASKEY,
Chief of the Mining Bureau.

The SECRETARY OF THE INTERIOR,
Manila, P. I.

EXHIBITS.

EXHIBIT A.

FINANCIAL STATEMENT, FISCAL YEAR ENDED JUNE 30, 1905.

Fiscal year 1905.	Allowed.	Expended.	Balance.
Salaries and wages	₱25,000.00	₱23,992.95	₱1,007.05
Contingent expenses	6,100.00	5,988.30	111.70
Total	31,100.00	29,981.25	1,118.75

EXHIBIT B.

NARRATIVE REPORT OF BENGUET FIELD WORK.

By A. J. Eveland, *Geologist.*

Mining Bureau, *Manila, June 29, 1905.*

Sir: In accordance with your instructions of March 10, 1905, proper equipment was selected, and on March 16 I left Manila via the Manila and Dagupan Railroad with one assistant, Mr. C. M. Weber, temporary employee of the Mining Bureau.

The work planned for the field season included an inspection of certain reported copper deposits in Pangasinan Province, the town nearest being Salasa, some 10 miles west of Dagupan. For this inspection, which was to determine, if possible, the advisability of further work, and to give such technical assistance as might be asked to those operating the properties, it had been arranged that I was to be met at Dagupan by Colonel Kennon, who would accompany me to the works. He was communicated with by wire, and as he failed to appear the day set by him I went without him to the mines via Lingayen and Salasa on March 18.

Four days were spent with the miners looking over the ground, and I returned to Dagupan March 24, meeting Colonel Kennon on route.

Report was made to the Chief of the Mining Bureau, under date of March 26, covering this portion of the work.

Wagons were procured at Dagupan and, being exchanged for carretons and cargadores at Twin Peaks and Colgan's Camp, Baguio was reached March 26.

The first week was spent in preliminary surveying work, tieing in to the triangulation work of the Benguet road surveys, and in running a short line (3 miles) out to J. F. Kelly's properties on the main Antimok trail. During some of this preliminary work fossils were collected from a large limestone bed just west of Baguio, the outcrop of which forms a prominent feature of the landscape.

Up to April 23 all but a little work, using Baguio as headquarters, was impossible. A series of illnesses, first of malarial fever for Mr. Weber, then of smallpox for a camp hand, and finally of appendicitis for myself, in two weeks, and simultaneously an absolute lack of even enough men to get the camp equipment out of Baguio, effectually prevented any carrying on of the work; but after that date work was resumed and prosecuted steadily until the advent of the rainy season.

Triangulation stations were put up, the topography of the country affording excellent sites, and were tied in with the Benguet road survey stations; and from them the topography carried on in the usual manner.

The weather as a whole was excellent for survey work, and even the occasional bad days could be used to plot some of the data needed in the field and to reduce the field notes, so that I was able to return to Manila with notebook completely up to date.

Toward the last day of May and the first of June some attention was paid to the geology and ore deposits of the Antimok region, which up to date were set aside for the completion of the work of first importance. All the tunnels and openings of this district were surveyed and plotted, such information as to the geology as could be hastily obtained was gathered, and about twenty-five samples of rocks and ores were collected, to be brought to Manila for examination and analysis. In accordance with your instructions and at the request of Messrs. Peterson and Reavis, three days were spent at the stamp mill they have lately put into operation, to aid them in the milling, if possible. It was found that, while the spirit and energy of these gentlemen are most praiseworthy and could well be duplicated by others, they are struggling under adverse conditions due to lack of knowledge of the work; and such information and help as I could give were furnished. Details of feed, stamp drop, water, oil on plates, and so on, were attended to, and such advice as I was capable of was given; I understand that the latter has been acted upon, a plate of 18 feet instead of the 18-inch one in place has been ordered; the mill is to be steadied and better arrangements to be made in general. Even under the present crude conditions I should judge that possibly the mill plated $10 to the ton during this run, which is an excellent indication of ultimate success.

A visit was made to the Batwaan Creek mining region, but it was found deserted, and as we had no food with us it was necessary to return to camp. Several efforts were made to connect with the parties interested in this region, to no avail, and therefore it was necessary to forego the examination desired.

One visit was made to claims in the "Bued River" region, the "White Horse" and "Grey Horse" of Mr. Petersen, and the outcrop examined. Owing to the early advent of the rainy season, the plans for spending some time at this district had to be changed, and postponed for the geological reconnoissance in the fall. A heavy storm commenced about the month of June and lasted until the party left Baguio on the 22d. So much rain fell that it was impossible to carry on further work, and so packing was commenced about the 19th.

Before leaving Baguio I obtained, in accordance with your instructions, lists of claims, workings, etc., the plans of the respective holders as far as they could be obtained, and considerable notes as to the ore deposits and geology in each case. At Twin Peaks I made an examination of the map of the Benguet road surveys, traced those to be used in my work, and obtained other information which will be of use in the preparation of my final report on this region; all this was most cordially given by Col. L. W. V. Kennon, and later by Mr. G. H. Hayward, in successive charge of the road.

Some little delay ensued in getting out of Baguio, but on June 22 enough polistas were procured through the friendly services of a Chino, and the trip made through into Manila in three days, arriving Sunday, June 22, by the same route as going.

Respectfully submitted.

A. J. EVELAND, *Geologist, Mining Bureau.*

Mr. H. D. MCCASKEY,
Chief of the Mining Bureau, Manila.

EXHIBIT C.

NARRATIVE REPORT OF WORK IN BATAN ISLAND, ALBAY.

By W. D. SMITH, B. S., M. A., *Geologist.*

MINING BUREAU, *Manila, June 17, 1905.*

SIR: In compliance with your instructions of March 13, 1905, and June 16, 1905, I have the honor to submit an advance report on the work assigned to my charge on Batan Island, Albay Province, and adjacent territory, during the months of March, April, May, and a portion of June.

According to instructions the work was that of collaboration with Lieut. H. L. Wigmore, in charge of exploration of coal deposits on the United States military reservation on Batan Island and that of obtaining all necessary information, including maps, samples, etc., for a complete report on the economic, paleontologic, and geographic geology of this region as far as time and funds have permitted in working over so large a territory.

On March 18, with the proper field equipment, the geologist proceeded to Liguan, Batan Island, by U. S. C. T. *Lal-loc* arriving there on the morning of March 23, where he was met by Lieut. H. L. Wigmore, whose mess he shared during his stay on that island.

The first day was spent with Lieutenant Wigmore in looking over the material and results of his previous work. The next day First-Class Private John R. Yeager, of the Corps of Engineers, and one native were detailed to the geologist as assistants during his entire stay. These men were found very efficient in their respective work. Private Yeager was invaluable in the prosecution of the work, as he had done practically all the instrument work on the military reservation.

In every way Lieutenant Wigmore assisted and made the geologist's first work in the Archipelago a thing to be always recalled with pleasure. Without his able work, in one of the most difficult pieces of exploratory work the writer has yet seen anywhere, much valuable data would not be available to commerce and science.

Lieutenant Wigmore also assisted in obtaining barotas, when the launch *Atlanta* could not be spared, and bolomen with whom to attack the jungle, which is particularly rank on this island.

The first two weeks were spent in getting a general idea of the region as a whole and in reviewing the work done by Lieutenant Wigmore and his corps of engineers. This latter work was done chiefly on Sundays and in the evenings. It was found, however, that even the most cursory examination could not be made in that time, owing to the great difficulty in getting over the country. If we left the shore, it was as a rule with one or two bolomen, and on reaching even the highest eminences and climbing trees we could see practically nothing of the surrounding country.

After this preliminary work we started with the triangulation work of the Coast and Geodetic Survey and the more detailed work done by Lieutenant Wigmore and his assistants as a basis, and instituted a series of traverses, crossing the island in various directions along streams and around the coast.

During the progress of this work we found it impossible to get back to our headquarters at night, though we were many times only a matter of a mile or so away, so that we generally stopped with the tenientes of the various coast barrios. At all times we found the natives friendly and very hospitable, willing to render any and every assistance. In return for these courtesies we endeavored to help many of them in learning English.

These people belong to a distinct tribe, known as Bicols, for the most part a peace-loving and thrifty people.

For perhaps a month or six weeks work was confined to the military reservation, as this was the prime object of the visit to Batan Island. Here the geologist was particularly impressed with the efficiency with which Army men, officers and soldiers alike, undertake propositions that are as a rule handled by men who have been specially trained in one thing. Everyone, extending even to the clerical force of whom Mr. W. H. Penny is chief, seemed imbued with enthusiasm for the work going on.

Here were found two diamond drills, unfortunately of limited capacity, at work under the supervision of experienced men from the United States. This is the first instance, to my knowledge, of the employment of the diamond drill for mineral exploratory work in the Archipelago. The coal on the reservation improved in quality and appearances with every foot of drilling and tunneling, so that the broken and slickensided appearance of the surface coals largely disappeared with depth.

After Lieutenant Wigmore's report had been completed and submitted attention was turned to the eastern end of the island, where three properties were examined, the Batan mine, mere prospect tunnels as yet, on Ex-Governor Betts's claim; the Chifladura, now in operation under the Japanese contractor, Mr. Ikeda, and belonging to the Batan Coal Mining Company, and the Bilbao, same company, now abandoned. At the Chifladura the output is 22 tons per day (twenty-four hours of three shifts).

Conclusions, which must necessarily be conservative at this time, are that the Liguan seams are in a lower geological horizon than those of the eastern beds, and hence better. I found other factors, such as transportation, harborage, proximity to sea level, etc., favoring the deposits at Liguan.

During the reconnoissance on the eastern end of the island, iron ore (hematite and limonite with some magnetite) was found, and samples were collected from which analyses are being made.

When the more or less detailed reconnoissance of Batan Island had been completed a trip was made to the Island of Rapurapu. Nearly a week was spent on this island, which proved to be very interesting geologically and may also prove so economically. The iron formation of Batan was found to continue on this island. Statements with regard to its extent, thickness, and quality will be made in the forthcoming final report. At the pueblo of Rapurapu a guide was obtained, and early in the morning of the 24th of May the party set out in a baroto along the south shore, disembarked about 3 miles east, and took a trail over the mountains to a reported gold mine. It has since been learned that the native did not take us to the old shafts, but to a place where placer work has been carried on. There reigns among these people a great fear of entering mines, and particularly one in which, as in this case, a number of men had lost their lives. These shafts can no longer be entered, I am told, so that probably nothing much was missed.

In the stream bed a color was obtained after only a few minutes panning. The rocks here are metamorphic schists and plutonic rocks, chiefly diorite.

After a trip across the island to the north shore and some study in that portion our party proceeded across the strait to Gotbo, the scene of former extensive coal mining on the part of the Spaniards; but first it should be mentioned that one outcrop of coal was located on Rapurapu on the low plain in the vicinity of the pueblo of the same name. The coal does not appear to be good and is only important for purposes of correlation.

At Gotbo examination was made of the old Spanish workings now abandoned, and in a sad way—another case of extensive preparations, great enthusiasm, and lack of proper superintendence.

This work concluded, the party returned by baroto to Batan.

During the following week a similar reconnoissance of Cacraray Island, lying to the west of Batan, was made with the following objective points: (*a*) The general geology; (*b*) prospecting for coal; (*c*) preliminary survey of route for proposed railroad from Legaspi to Coal Harbor.

The following week was spent mainly in reconnoissance work on the "mainland" in the vicinity of Mayon Volcano. A trip was all arranged for by Captain Castner, Fourth Infantry, United States Army, and the geologist, for the ascent and geological study of this interesting and difficult volcano. However, the transfer of the Fourth Infantry just at the time set postponed this trip indefinitely.

The courtesy of the officers of the Fourth Infantry and the civil authorities and citizens of Albay Province and their interest and assistance in many ways were very gratifying to the geologist in his work in this neighborhood.

Owing to the lack of further funds and unavoidable difficulties in regard to transportation by land and water, much work that might have been carried on had to be abandoned until a more favorable time. However, a continuation of work in this field is promised at no distant date.

With this preliminary work completed, all available maps, mine plats, collections of rocks, fossils, coal samples, etc., made, the party was disbanded and the geologist embarked on the U. S. C. T. *Lal-loc* the afternoon of the 12th of June and proceeded to Manila, arriving there the morning of the 15th.

Work is now being done on the preparation of the geologist's final report, which will be a treatment from the following main points of view, according to instructions of the Chief of this Bureau:

(1) *Field work:* Purposes, plans, area covered, etc.

(2) *Geography:* Location, area, trails, streams, chief towns, important barrios, water transportation, harbors, etc.

(3) *General:* Climate, vegetation, timber, population, characteristics of people, etc.

(4) *Hydrography:* Streams, water supply, drainage, etc., with special reference to mining operations.

(5) *Topography:* Features of country, orography, water sheds, with special reference to development by road, railroad, water transportation, etc.; altitude, slopes; maps, profiles, and sketches.

(6) *General geology:* Igneous, metamorphic, and stratified areas; volcanic activity and remains; fossils, distribution of; geological structure, folds, faults, dikes, etc.; geological horizons, with special reference to coal deposits; maps, sketches, sections.

(7) *Rocks:* Petrographic and lithological notes and data; descriptions, determinations of rocks, and discussions.

(8) *Coal deposits:* Occurrence, relations, thickness, pitch, quality, etc.

(9) *Present methods of mining and treatment:* With sketches, plans, etc.

(10) *Other nonmetallic mineral resources:* Location, extent, relation of deposits to geological environment, analyses, discussions.

(11) *Mines and claims:* Names of locators, owners, or lessees; output, plan for development, and all important phases of the situation.

(12) *Summary:* Estimate of values; assays and analyses, and discussions; suggestions as to development; discussions of labor, transportation, supplies, costs, methods of mining and shipment. General.

During the prosecution of the field work nothing more than the physical features of the country impeded the work and not a day was lost through sickness.

Batan Island is doubtless one of the most healthful and beautiful spots in these Islands. The geologist is very much encouraged over the conditions affecting mining and geological work in the Archipelago, conditions which are continually being exaggerated and misrepresented by parties whose examinations have been necessarily superficial.

Respectfully submitted.

W. D. SMITH, B. S., M. A.,
Geologist, Mining Bureau.

Mr. H. D. MCCASKEY,
Chief of the Mining Bureau, Manila.

EXHIBIT D.

REPORT UPON THE BULACAN IRON INDUSTRY.

By MAURICE GOODMAN, B. S., E. M., *Field Assistant.*

MINING BUREAU, *Manila, September 1, 1905.*

SIR: In accordance with your written instructions dated August 4, 1905, I have the honor to submit herewith a report upon the present condition of the iron industry in the Angat region, statistical information regarding cost and amount of production for the calendar year 1904, and a report upon the probable opportunities of the extension of the iron industry in the Angat district.

The report is based upon information obtained by me during a six days' visit to the district. I left Manila on the morning of August 8, arriving at Baliuag the same morning; there hired a carromata and drove to Angat, arriving there about four and a half hours after leaving Manila. The following morning I left Angat on foot and reached the region of the iron mines in the afternoon, after about four and a half hours of actual traveling. The trail, which was almost entirely uphill from Angat, was muddy and in rather bad condition owing to recent heavy rains. The two following days were occupied in visiting the working places of the different mines and in obtaining data required, both from my own measurements and from information supplied by the operators of the different blast furnaces.

On the fifth day after leaving Manila I returned to Angat and spent the afternoon of this and the morning of the last day in interviewing the owners of the iron mines, all of whom live in Angat. All of them allowed me to look over their books, but in nearly every instance their accounts had been begun since January 1, 1905 (prompted thereto by the enforcement of the new Internal Revenue Act), and were therefore of little value to me. In the future, however, these books will be of material assistance in securing statistical information.

At the time of my visit to the mines only two furnaces were in actual operation. Of these, that of Francisco Vergel de Dios, on the Constancia claim, was blown in during my visit to his camarin, and the other, that of Maria Fernando, on the Hison claim, was expected to be run for another week before lack of charcoal caused it to be blown out. Three more furnaces in the district—that of José Ong Sayco, that of Mariano Santiago, and that of Mariano Suarez—although not working at the present time, are only temporarily idle for lack of labor, fuel, or funds. Altogether, therefore, the Angat iron mines support at the present time five blast furnaces, working intermittently throughout the year.

There are at the present time fourteen mining claims held in the Angat iron region, four of which are concessions granted during the Spanish régime and the remainder are claims located under the existing mining laws. Only two claims are worked at present. One of these is the Constancia claim and supplies ore to the furnace of Francisco Vergel de Dios, who now owns both claim and furnace, having recently inherited both from Pedro Otayco. The other claim feeds all the other four furnaces when they are in operation. Its ownership is disputed by Mariano Santiago, Mariano Suarez, and Maria Fernando. At present all these claimants, as well as José Ong Sayco, are taking ore from the same river bed, each claiming it to be within his or her concession. Only Ong Sayco has recognized the claim of Maria Fernando and is paying her a tribute of 50 pesos annually for the privilege of taking ore from her concession.

Up to the present the average monthly production for 1905 is approximately 19,150 pounds, about 6½ per cent less than the average monthly production of last year. This falling off is due to the closing down of all operations during the month of June, caused by the presence and fear of a band of ladrones who terrorized the district for a short period. This band has since been broken up and the furnaces are again working at their normal rate.

The cost of production of the products of the Angat blast furnaces may be divided into the following items:

Mining: Stripping; transporting to camarin.

Smelting: Charcoal, labor, repairs, and molds.

Transportation.

Taxation: Internal revenue, territorial, and ad valorem.

MINING.

To keep one furnace constantly supplied with ore it is necessary to employ in stripping—

6 men at ₱0.30 each	₱1.80
1 maestro	.50
Total per day	2.30
For a year of 250 working days, ₱2.30 × 250	575.00

A single furnace turning out about 560 pounds of castings per day requires in the neighborhood of 1,140 pounds of ore and about 1,500 pounds of charcoal during the same period. The cost of the transportation of the ore from the mine to the camarin, a distance of about a quarter of a mile, costs ₱0.20 per load, which consists of a split bamboo pole carrying two baskets loaded with hematite bowlders weighing about 130 pounds per load.

For a year of 250 working days, or twelve workings of the furnace for periods of 20 to 21 days each, the cost of the transportation would be

$$\frac{1,140}{130} \times 250 \times \text{₱}0.20 = \text{₱}438$$

SMELTING.

The first and most important item which enters into the cost of smelting is the cost of charcoal, the only kind of fuel employed for the purpose in this district. It is usually manufactured by the operators themselves, part of the labor required, however, being paid for by contract. The approximate cost of production of a stack containing about 144 cubic meters of wood, reducing to about 115 cubic meters or 2,553 bushels of charcoal weighing 5,160 pounds, is as follows:

Cutting about 3,000 logs, various sizes	₱70.00
Transporting same from forest to camarin	60.00
Cutting and transporting to camarin small sticks (about 55 talacsanes)	27.00
Transporting timber from camarin to stack and building up of same (per contract)	58.00

Laborers employed during combustion	₱28.00
Uncovering and removing charcoal from stack after combustion	25.00
Transporting charcoal from stack to camarin	26.00
	294.00
Forestry tax (last year, ₱57.60)	46.80
Total	340.80
Rate per ton of 2,000 pounds	13.35

About eight such stacks of charcoal will be required yearly for a furnace working 250 days, making the total cost of charcoal per year ₱2,726.40.

Daily cost of labor.

2 maestros, at ₱0.75 each (this includes cost of subsistence)	₱1.50
1 molder (this includes cost of subsistence)	.58
4 blowers, at ₱0.50 each	2.00
10 ore breakers, at ₱0.25 each	2.50
Total	6.58
For 250 working days	1,645.00
Cost of clay molds (left in plow points)	75.00

TAXATION.

Other than the forestry tax paid for cutting the timber used in making charcoal, mine owners and operators also pay two kinds of internal-revenue tax, namely, a territorial tax on mineral concessions and an ad valorem tax on the metal product. The first of these is at the rate of 100 pesos per 60,000 square meters, and the second is 3 per cent of the market value of the product. The internal-revenue tax went into effect January 1 of this year and supplanted the old industrial tax, which operators formerly paid, of ₱60 for each blast furnace. It is perhaps too early to mark the effect, if there be any, of this new tax on the industry. I know of only one who had up to the time of my visit to Angat paid the territorial tax, in spite of the fact that the law states that the tax shall be paid yearly in advance, and that any concessionaire who fails to pay the tax shall forfeit his right to the mining concession (Art. XV, Act No. 1189, United States Philippine Commission).

None of the owners complained of or criticized the imposition of this new tax, though they would, of course, all have been better contented with the former schedule. Maria Fernando, the only operator who up to the time of my visit to Angat had paid the territorial tax, did complain, however, that she had been given to understand that when the new internal-revenue tax went into effect she would be allowed to cut timber on her concession for the purpose of charcoal making free from taxation. Up to the present, however, though she had paid the territorial tax, which amounted to ₱686.33 in her case, she had to continue to pay the forestry tax as before. She said that she did not so much object to the cost of the forestry tax as to the trouble, delay, and annoyance which the collection of it involved. This, she admitted, had greatly ameliorated since the appointment of the present *montero* of Angat. She has since applied for a gratuitous license under section 17 of the Forestry Act, by the provisions of which she is seemingly entitled to exemption from the forestry tax.

With respect to the 3 per cent ad valorem tax, but one operator so far has paid it; although again Article XV of Act No. 1189, United States Philippine

Commission, distinctly specifies that the ad valorem tax shall be paid before any of the products of the mine may be removed. This operator has recently written to the Collector of Internal Revenue, asking for his opinion on the question of whether or not the operators of the Angat iron region are exempt from the payment of all internal-revenue taxes. Their claim thereto is based on section 60 of the act of Congress of July 1, 1902, in connection with articles 1 and 2 of the Spanish royal decree of November 21, 1895. This decree (Abstract of the Mining Laws in Force in the Philippine Archipelago, compiled by Chas. H. Burritt, p. 95) extends the period of exemption from annual fees, enjoyed by iron and coal mines, and postpones the impost of the 3 per cent ad valorem tax until 1917. Section 60 of the act of Congress reads: "That nothing in this act shall be construed to affect the rights of any person, partnership, or corporation having a valid, perfected mining concession granted prior to April eleventh, eighteen hundred and ninety-nine, but all such concessions shall be conducted under the provisions of the law in force at the time they were granted, subject at all times to cancellation by reason of illegality, etc." Whether or not the exemption by royal decree extended until 1917 may be considered a right of the concessionaries is a question to be decided. This is a matter of considerable importance to the future iron and coal industries of the Philippine Islands, and should be definitely settled. Up to the present, it is believed, the Collector of Internal Revenue has not expressed his opinion on the question, it having been referred to him but a few days ago by one of the operators of Angat.

TRANSPORTATION.

One of the most important factors entering into the cost of production is the cost of transportation of the iron plowshares and points from the mines to Manila. Three modes of transportation are required, beginning with the cargador from the smelter to Angat, a distance of about 15 miles, then by bull carts to Baliuag, a distance of about 12 miles, and finally by railroad to Manila. The first stage is naturally the most expensive, and costs at the rate of ₱0.80 (formerly ₱1) per ten pairs of points and shares of whatever size, averaging about 7.9 pounds per pair. From Angat to Baliuag by bull cart the rate is ₱2.50 per 100 pairs, averaging 6.8 pounds per pair, the reduced average weight being due to the fact that now a single large share is considered as equivalent to a pair of smaller ones or to a pair of points. During the dry season the iron is sometimes sent to Baliuag by banca, at the rate of ₱2 per 100 pairs, averaging 6.8 pounds per pair. This method of transportation, however, is not reliable, being possible only during short periods of the year, and therefore is not much used. By rail from Baliuag to Manila costs ₱1.50 per 100 pairs, averaging 6.8 pounds, and from the railroad station to the dealers in Manila costs about ₱0.65 for the same load.

Cost of transportation.

	Pounds.	Cost.	Per 100 pounds.
From smelters to Angat	79	₱0.80	₱1.013
From Angat to Baliuag	680	2.50	.368
From Baliuag to Manila	680	1.50	.221
From station to dealer	680	.69	.096
Total cost per 100 pounds			1.698

But few supplies are sent from Angat to the smelters in the mountains. The most important of these is rice for the subsistence of those laborers part of whose wages are paid in this commodity. The present cost at Angat per cavan (about

2⅛ bushels, weighing about 125 pounds) is ₱4.50, and the cost of transporting the same to the mines is ₱1.25.

The following table gives an idea of the relative average costs per year of producing and marketing about 20,600 pairs of plowshares and points, weighing approximately 140,000 pounds, in a typical blast furnace in the Angat region working 250 days:

Item.	Per year.	Per 100 pounds.	Per long ton.	Per cent.
Mining	₱575.00	₱0.411	₱9.21	6.2
Transportation of ore to furnace	438.00	.313	7.01	4.7
Charcoal	2,726.40	1.947	43.61	29.4
Smelting and molds	1,720.00	1.229	27.53	18.6
Transportation to Manila	2,377.20	1.698	38.04	25.7
Internal-revenue tax on one pertenencia	250.00	.179	4.01	2.7
Internal-revenue tax, 3 per cent ad valorem	333.54	.238	5.33	3.6
	8,420.14	6.015	134.74	90.9
Incidentals, 10 per cent	842.01	.601	13.47	9.1
Total	9,262.15	6.616	148.21	100

The market value of the product is assessed at the rate of ₱54 per 100 pairs of points or shares.

Market value of product	₱11,124.00
Total cost	9,262.15
Profit	1,861.85

Production for calendar year 1904.

Operator.	Weight, short. tons.	Charcoal consumed, short tons.	Value of product.
Maria Fernando	71.469	204.2	₱12,238.50
Francisco V. de Dios	24.071	69.1	3,950.53
Mariano Suarez	18.426	52.8	2,737.80
Mariano Santiago	8.934	25.6	1,243.31
Ong Sayco	---	---	---
Total	122.900	351.7	20,170.14

The above figures are close estimates, based chiefly upon the records of the *montero* of the district and such other reliable data as were obtainable from the proprietors. Only one of the operators kept a book giving full and detailed items of income and expenditure. Such estimates as the proprietors were willing to give were, it was suspected, mostly incorrect, and therefore not utilized. For example, one of the biggest operators in the district, in answer to inquiries as to his output, produced a copy of his declaration to the provincial treasurer of Bulacan, in which he states that between July 4, 1901, and the end of December, 1904, he produced in all about 6,000 pairs of shares and points. Yet from the amount of charcoal burned by him last year, it was estimated that his output alone was nearly equal to the output declared by him for the two and a half years, and his own records, which he has been required to keep since the introduction of the internal-revenue law, showed that during the first six months of this year he has already produced and sold 2,300 pairs.

The value of the output varies considerably with the time and place where the iron is sold. Some of the operators draw their money in advance, or practically borrow a sum of money from the dealers in iron, and then repay in stock, for which they naturally obtain a much lower figure than if sold directly. This accounts for the large discrepancy in the value of the output of the different operators.

EXTENSION OF INDUSTRY.

The probable opportunities for the extension of the iron industry in the Angat region are very difficult to determine at present, owing to the fact that much important data, which are necessary for a full and complete discussion of the subject, are lacking. For example, although nearly all the known outcrops of iron ore in this district were visited, the information derived thereby is insufficient to offer even a suggestion as to the available ore supply. The outcrops observed were anywhere from a quarter to 2 miles apart, and were all so massive and hard that the native miners, using nothing but picks, hammers, and bars, were unable to work them. Their ore supply is derived entirely from bowlders, which have been worn and broken from the outcrops, and which the miners to-day simply dig out of the creek bottoms, break into convenient sizes, hand-sort, and send to the furnaces above. No development work having been done upon the seams themselves, the average depth, strike, thickness, and general character of the deposit or deposits being therefore undetermined, it is impossible to give any figures whatever regarding the amount and value of the available ore supply.

The question of ore supply has never troubled the local operators for the reason that the cost of erection of one of their furnaces is extremely small, their output also very small, and their faith sufficiently large to trust that the creeks which have been supplying them and their ancestors with ore for nearly a hundred years will continue to do so at least during the life of their furnace. A comparatively large blast furnace, such as the hypothetical 10-ton furnace you suggested in your letter of instructions, would consume per year nearly thirty times as much ore as did all the furnaces together during 1904, and its cost for fire brick and erection alone would be more than three times the cost of any furnace (excluding the camarin) in operation in the Angat region to-day. I would therefore suggest that before going to the expense of the erection of a large blast furnace in the region, it would be highly advisable to institute a system of exploration which would afford as much and as definite information as possible regarding the extent, character, and value of the deposits. This need not necessarily be an expensive undertaking, for the prospecting may be done either by the diamond drill or by sinking and drifting in the seam itself. While the former method may be much the quicker the latter would yield fuller and more detailed information than could be derived in any other manner, while at the same time the ore taken out in drifting would pay the expenses of the exploratory work.

Assuming the information derived from such exploratory work to be satisfactory, the plant no doubt would be erected close to the mines, thereby saving to a large extent the cost of transportation of the ore as well as of the fuel, which is abundant in the neighborhood. Its exact location would depend largely upon the result of the exploratory work, on the topography, and on the method of mining decided upon. If it is proved, as seems probable, that the main deposit lies in Mount Maon, and if it is decided to open the mine either by vertical shaft from above or by tunnel below, a good location for the plant could be found on the hill above the Hison outcrop. Here plenty of water and abundance of timber are available at present, the main trail from Angat could be easily extended to the plant, and there are sufficient drop and space for a slag dump.

In accordance with your suggestion I submit in connection with this report a design of an improved blast furnace which may be erected in the iron regions of Bulacan, at a very reasonable figure, its capacity to be about 10 long tons per twenty-four hours. It is designed with an eye chiefly to simplicity of construction, and, bearing in mind the difficulties of transportation, as little foreign material and appliances as practicable are introduced. It is circular in plan, the diameter at the crucible being 4 feet, at the boshes 8 feet, and at the throat 5 feet; height from the bottom of the crucible to the throat, 31 feet. It is designed to be charged by hand, the charge consisting of ore, limestone flux, and charcoal. The hot gases escaping from the furnace are to be allowed to run to waste through a chimney, 9 feet high, built over the throat. A cold blast introduced through three tuyeres is to be used. Further details may be seen in the accompanying design.

The design would unquestionably be greatly improved if provisions were made for water cooling at the boshes, tap holes, and tuyeres. As it is, the most vulnerable parts of the furnace will probably have to be replaced and repaired much oftener than they otherwise would. Labor and material, however, being inexpensive, unless it becomes necessary to blow out the furnace, the annual cost of repair will not be very large.

An approximate cost of material and erection of the furnace would be—

Foundation	₱1,100.00
Shaft	1,850.00
Columns	200.00
T-bars, bands, and doors	560.00
Air pipes and tuyeres	75.00
Miscellaneous	300.00
Total	4,085.00

IMPORTS.

The following table is the result of inquiries of the local dealers and consumers regarding the amount, quality, and value of the pig iron which was imported into the Philippines during the fiscal year 1905:

Imported by foundries and dealers.

Grade.	Long tons.	Value, in pesos, per long ton in Manila.
No. 1	275	50.00 to 55.00
No. 3	235	48.00 to 53.00

Imported by United States Navy.

Grade.	Long tons.	Value, in pesos, per long ton in Manila.
No. 1	50.2	34.00 to 37.40
No. 2	225	29.40 to 36.40
No. 3	250	28.40 to 36.50
Assorted	235.8	26.00 to 55.00

The total value of the 761 tons of pig iron imported by the United States Navy during the fiscal year 1905 was ₱2,739.60, making an average of ₱31.60 per long ton. This figure does not include the cost of freight, lighterage, or customs duties.

From the foundrymen interviewed it was learned that the importations during the last two or three years have fallen off fully 50 per cent from what they had been for the three years previous to 1901. This is probably but the natural reaction following upon a period of unusual business activity, stimulated by and attendant upon the presence of large military and naval forces in the Islands during the years 1898 to 1901. Those who have been in the Islands previous to

1898 admit that the conditions of the iron trade are better to-day than they had been previous to American occupation. However, many complain that, unless a piece of work is urgently needed, the order is usually sent to Hongkong or Shanghai, where labor, supplies, and other expenses are cheaper, thus enabling the foreign foundries to underbid the local ones.

A piece of cast iron broken from one of the plowshares made at Angat was shown to several foundrymen, and they without exception considered it a good workable cast iron and believed that, if it could be brought to Manila in pigs at a price equal to what they were paying for the imported kind, it would have a ready market, though perhaps a small one owing to the small demand. However, in view of the figures obtained from the Third Special Report of the Collector of Customs for the Philippine Islands, which show that over ₱4,800,000 worth of steel, wrought iron, and cast iron, and articles manufactured from these metals were imported during the fiscal year 1904, it would not seem improbable that, if a dependable supply of pig iron of a good grade were available in the Philippine Islands, an increased demand for the same might be created.

To give any figures as to what the probable interest on the investment would be is a difficult matter, in view of the many unknown quantities which are essential to even an approximate solution of the problem. For instance, it is at least necessary to know what the character and the market value of the product is to be.

It has been shown that under existing conditions a furnace operating 250 days in the year, and turning out about a quarter of a ton of iron per day cast into shapes of plow shares and points, would make a net profit of about ₱1,861.85 on a total cost of ₱9,262.15 for production, or about 20 per cent profit. But a large furnace, turning out about 10 tons of metal per day, if cast into plow shares and points alone, would in a very short time flood the market and find the sale of its product impossible. To produce pig iron alone, a product which could be more readily disposed of in Manila, would cost practically as much per ton as it does to produce plowshares; but while the latter can be sold in Manila at the rate of about ₱183.80 per long ton, it would be difficult to dispose of pig iron at more than ₱55 per long ton.

The cost of production and marketing under present conditions is about ₱148.20 per long ton. Of this, the cost of charcoal alone, which is consumed at the not too excessive proportion of abut 2.8 tons per ton of iron, is ₱43.61 per ton of iron produced, and the cost of transportation from the smelter to Manila is ₱38.04 per ton. These two items alone amount to ₱26 in excess of the selling price of pig iron in Manila. It is undoubtedly true that the cost of transportation could be very largely diminished by the construction of either a wagon road or some mechanical means of transportation, such as wire-rope overhead tramway, between the smelters and Angat. In fact, an improved mode of transportation would be absolutely necessary to a new 10-ton furnace, for even now, although the combined product of all the furnaces is but one-thirtieth of the proposed output from the projected furnace, operators frequently find considerable difficulty, especially during the planting season, to obtain sufficient cargadores and laborers.

The smallest practical rope tramway which could be constructed would cost in the neighborhood of ₱35,000 and would have a normal capacity of about 50 tons per day. It would reduce the cost of transportation from the smelters to Angat from ₱22.70, the present cargador rate, to about ₱3 per long ton. On a wagon road for the same distance the cost of transportation would be about ₱10 per long ton, and the construction of such a road would cost in the neighborhood of ₱20,000. As stated before, some improved method of transportation would be absolutely essential, not only on account of increased economy, which, however, would be ample reason in itself, but also because it would be impossible to obtain sufficient cargadores to transport the product as it is done to-day.

It is evident that even after deducting whatever economies might be effected in the cost of transportation, the total cost of production and marketing would still remain largely in excess of the selling price of pig iron in Manila, and that to build up an industry for the manufacture of pig iron in the Angat region must prove an unprofitable undertaking. But I believe that a profitable foundry practice could be built up to manufacture special castings as well as regular shapes, such as cast-iron pipes and fittings. Special castings of simple design cost ₱0.15 per pound in Manila, and ordinary cast-iron pipes cost about ₱0.11 per pound, while the plow shares and points which are brought down from Angat sell for only a little over ₱0.079 per pound and cost to produce and to market only ₱0.066. In addition to this, as produced at present from high-grade ore, in small charcoal, cold blast furnaces, the resulting iron is of a high grade and freer than the imported stock of those detrimental elements which tend to reduce the value of cast iron. An important advantage possessed by the Angat operators is the fact that, owing to the unusual purity of the product of their furnaces, they are able to cast directly from the molten metal obained from the blast furnace, without having to go through the costly intermediate process of remelting in a cupola.

Unfortunately, it is impossible to determine from the custom-house reports what portion of the iron products imported are of cast iron and of such shapes as to be readily manufactured in the Islands. But it seems quite probable that, although under present conditions the establishment of a profitable industry for the manufacture of pig iron would be impossible in Angat, with an annual importation of nearly ₱5,000,000 of iron and steel products, a profitable, even if small, foundry business could easily be built up.

Respectfully submitted.

MAURICE GOODMAN, B. S., E. M.,
Field Assistant, Mining Bureau.

Mr. H. D. MCCASKEY,
Chief of the Mining Bureau, Manila.

EXHIBIT E.

REPORT UPON BUILDING STONE NEAR MANILA.

By H. M. Ickis, E. M., *Field Assistant.*

Mining Bureau, *Manila, March 20, 1905.*

Sir: In compliance with instructions from you under date of January 31, 1905, I have the honor to submit the following report with respect to my recent field work in the Provinces of Laguna and Rizal:

The object of this trip is outlined in the above instructions and was "to ascertain whether or not there is a stone within the region outlined of sufficient quantity, of fair quality, and of favorable location with respect to quarry sites and transportation, for the establishment of quarries to be worked by convict labor," and to make geologic notes of general interest.

ITINERARY.

I left Manila on the launch *Mabait* of the Yangco line at 7 a. m. on February 2 and arrived in Los Baños six hours later. After presenting my letter of introduction to First Lieutenant Thomas, First Cavalry, United States Army, in charge of the rock-crushing plant and road work at Los Baños, I visited in turn the quarry and rock-crushing mill, the Dampalit River as far as the first falls, the cuts in the road to Calamba, and the clay beds of Paja arroyo on the south side and the low hills on the east side of Mount Maquiling.

From Los Baños transportation was by boat to Santa Cruz, which was used as a base while investigating the region near that arm of the lake. You joined me at Santa Cruz on the evening of February 7 and during the two following days a journey was made to the beautiful Pagsanjan canyon, then by way of Cavinti and Luisiana to Botocan Falls, returning by way of Majayjay and Magdalena.

It was found necessary to spend one night in Paete. Paquil, Pangil, and Siniloan were then seen, and on February 11 return was made to Santa Cruz by banca, touching at Mataquio.

Transportation from Santa Cruz to Jalajala was by banca via Bagombong. One day was spent among the hills east of Jalajala, and on February 14 I took a banca for Tanay, following closely along the shore.

After a tramp over the hills near Tanay a banca was taken to Morong, where I obtained another banca to Subay, Talim Island.

In company with Mr. Haygood, the engineer in charge of the city quarry at Subay, I circumnavigated Talim Island by banca on February 16, and on the 17th the launch *Comandante* was boarded for Binangonan.

After inspecting the rock exposures along the lake shore, the site of the old quarry of the city of Manila, and the limestone on the road to Antipolo, return was made to Manila on the *Comandante* on February 19.

NOTES.

The quarry at Los Baños from which Lieutenant Thomas obtains rock for the roads under his supervision and for shipment to Fort McKinley is situated on the east wall of Dalampit Canyon about half a mile southwest of the Los Baños pier.

The working face is 200 feet long and nearly 100 feet high. Its length can easily be increased, and it will soon be 200 feet high, provided the present base level is adhered to. A streak of soft ashy rock about 50 feet wide divides the present face into two equal areas.

The rock, a feldspar-porphyry (f. n.), quarried is vesicular, is not uniform in composition, and has no regular parting planes. In some parts of the quarry the rock has a distinctly banded structure, as shown in sample No. 1.

The rock is broken down first by large blasts, and then further broken by plaster blasts, and finally reduced to crusher size (7 inches or less) by hand sledges. The crushing plant is located on the low river bottom land about 200 yards northwest of the quarry. It consists of a No. 3 Gates gyratory crusher, a revolving screen, and the necessary engine, boiler, feeding, and shoveling platforms. The capacity of the crusher with this rock is 90 tons to 2½-inch size per day of nine hours. The screen separates out fines for surfacing the roads besides the regular 2½-inch road metal. Transportation of the rock to and from the mill is by four-wheeled wagons with American horses and drivers. Rock for Fort McKinley is hauled to the pier and dumped directly into scows. More than 300 native laborers are employed on the road work and in the mill. They are paid 50 cents per day (Philippine currency), while the Filipino foremen receive ₱1. A large proportion of the laborers come from Batangas.

The Dampalit Falls are approximately three-fourths of a mile from the mouth of the river of the same name and nearly a mile southwest of Los Baños. At the falls, which are between 60 and 70 feet high, the river flows in the direction N. 30° W., but its general direction is nearly due north. Trees of considerable size and a tangle of undergrowth cover the sloping sides of the canyon, which are necessarily much higher than the waterfall.

The rock at the falls closely resembles that found at the quarry near the mouth of the canyon. It is very irregular in appearance and composition, but all consists of a dark-brown mass with light-colored phenocrysts of feldspar, and would be called a feldspar-melaphyre (f. n.). It breaks in irregular shapes and much of it is vesicular, while it lacks nearly all the qualities of a good building stone. (Samples Nos. 2 and 3.)

There is a 30-foot cut about a mile from Los Baños on the road to Calamba which Lieutenant Thomas is constructing where the road cuts through a spur of Mount Maquiling. The top of the ridge in which the cut is situated consists of volcanic tuff, but the lower 20 feet is mainly composed of a harder volcanic rock intermixed in its upper portion with the softer tuff. This rock, a feldspar-melaphyre (f. n.), breaks out in small, irregular bowlders. It makes a fairly good road metal, but is not a dimensional stone. Specimen No. 4 is a sample of the rock.

In the Paja arroyo about 3 miles west of Los Baños and 1½ miles from the lake occurs a deposit of white clay which at present is being mined, sacked, and carried on the backs of natives to the Los Baños road; thence it is carted to Los Baños and shipped to Manila.

The arroyo is quite heavily wooded with hard-wood trees of large sizes, and no clearing has been done.

The method of working is to sink pits about 3 feet square and 10 feet deep and then to run out low drifts into the best clay. At the time of my visit there were two groups of these pits, one on each side of the arroyo and about 400 feet apart. Each group consisted of three pits about 10 feet deep with drifts at the bottom from 4 to 8 feet long.

All of the clay contained brown iron-stained streaks, but below the first 2 feet the percentage of iron-stained material is very small. For a depth of 2 feet the clay contains some organic matter, besides a considerable percentage of iron, and is very plastic. The firm, white clay below varies greatly as regards plasticity. Most of the material exposed in the various holes possesses this valuable quality to a limited extent only, but one pit on the west side of the arroyo furnishes a pure white clay highly prized by the workmen, which is much more plastic. Sample No. 6, taken from the largest pit on the east side of the arroyo, represents the first class, while No. 7 is a sample of the more plastic clay.

It was impossible for me to determine the extent of this bed of clay owing partly to the limited time at my disposal and partly to want of exposures or extensive development work. But from surface indications the deposit seems to be large. No stratification was apparent, and below the first 2 feet there was no change in the character of the clay except in the plastic clay in one of the western pits, as noted above. The clay is used to calk bancas and also as a paint or whitewash.

The trail from the mouth of the arroyo to within a short distance of the workings passes over volcanic tuff which has been worn away in places to a depth of 6 feet. The elevation of the deposit above the level of the lake was estimated to be between 700 and 800 feet.

I was unable to find an exposure of good rock northwest of Los Baños. Volcanic tuff alone was in evidence for a distance of 2 miles inland.

The area in the vicinity of Santa Cruz for about 4 miles on each side is low, flat land or low hills supporting cocoanut groves.

About half a mile south of the town of Pagsanjan one enters the famous gorge of that name. The vertical walls of this canyon, 300 to 400 feet in height, covered with vines, shrubs, and small trees, with the clear mountain stream between, present a most beautiful and impressive picture. The canyon walls are remarkably parallel and are seldom 100 feet apart.

At the entrance of the canyon occurs a small exposure of what appears to be a solid igneous rock in place, but it shows for only a few feet along the banks. The walls of the canyon proper are composed throughout of a conglomerate of dark-colored igneous rock bound together with a soft basic cementing material of medium hardness. The bowlders present a variety of forms, but in a general way they are similar, being composed mainly of dark-colored silicates, and all are fine grained. Some are vesicular, while others are very compact. Many of the bowlders in the stream have a smooth black outside coating, probably a deposit of iron compounds. No quartz was detected in any of the rocks, but particles of jasper and small quartz crystals were found in the sands of the stream beds. The conglomerate beds showed distinct lines of stratification, and the dip as determined by you is 5 to 6 degrees in the direction N. 85° W.

When ascending the river the first waterfalls encountered are the Talontalagib Falls, which come tumbling down a hanging valley and over the east wall. At this season of the year (February) the stream is small and a considerable portion of the water splashes down over the rock instead of falling clear. The slope of the wall at the falls is about 80°.

As shown by maps, this canyon leads to Cavinte, where the natives say there is a waterfall of the main river.

The Botocan Falls are on the Botocan River, which joins the Pagsanjan on the west at the town of Pagsanjan.

One-quarter of a mile above the town of Pansanjan on the west bank of the river there stands a stone bath house which was built by the Spanish Government and supplied with water from a mineral spring near by. The following description of this spring may be of interest. It is a translation from the "Memoria Descriptiva de los Manantiales Minerales Medicales de la Isla de Luzon," by D. Jose Centeno, 1890:

"WATERS OF BOMBOÑGAN, PAGSANJAN, LAGUNA.

"*Topography and geology.*—On the left bank of the Bomboñgan River about 300 meters above its junction with the Balance, where the town of Pagsanjan is situate, and 5 meters above the water level of the river, a large spring gushes forth whose waters are used with great faith by the natives of the Province of Laguna for many of their ailments.

"The spring seems to be in a recent conglomerate of volcanic rock; but it is to be presumed that in the interior it runs over banks of volcanic tuff, which constitutes the subsoil of all of this region and which begins to appear on both banks a short distance from the spring and at a lower level.

"*Springs.*—Although only one is ordinarily spoken of, there are various springs in the vicinity of the one which is generally used, and is known by the name of Bomboñgan. The waters of this last one are gathered by means of a small canal in a basin of rubblework, inside of a small house which serves as a shelter for the bathers.

"The volume of the spring whose waters are collected for the bath, calculated from data taken on the 3d of August, 1885, was found to be 2.31 liters per second, or approximately 200 cubic meters in twenty-four hours, it being possible, if found necessary, to triple this amount of mineral water, collecting from the near-by springs that which is now wasted.

"*Physico-chemical characteristics of the water.*—Colorless, odorless, transparent, and has a slight inky taste scarcely perceptible. No reaction with litmus paper. Without bubbling gases. Temperature of water, 31.5° C. (air at 30° C.). Variation in temperature hardly perceptible. Density at 0° C. and 760 mm.; pressure = 1.003906.

"*Results of analysis.*—The anhydrous substances found in one liter of mineral water were:

	Grammes.
Carbonic acid, free	0.286240
Oxide of iron in the residue from evaporation	.004140
Oxide of calcium in the residue from evaporation	.034832
Oxide of magnesium in the residue from evaporation	.027529
Oxide of iron in the water, boiled and filtered	.017000
Oxide of calcium in the water, boiled and filtered	.007280
Oxide of magnesium in the water, boiled and filtered	.002928
Silicic acid	.062400
Sulphuric acid	.010301
Chlorine	.012864
Sodium oxide	.005299
Nitric acid	Trace.
The fixed residue obtained by evaporating directly 1 liter of the mineral water and drying at approximately 180° C. weighed	.380000

"*Definite analytical result, deduced by calculation.*—One liter of water at 31.5° C. contains in solution—

	Grammes.
Oxygen, 1.754928 cc	0.002509
Nitrogen, 11.783071 cc	.014800
Carbonic acid, 84.750000 cc	.167358
Iron carbonate	.009200
Calcium carbonate	.089568
Magnesium carbonate	.086615
Calcium sulphate	.017511
Sodium chloride	.012844
Magnesium chloride	.006855
Ferric oxide	.017000
Silicic acid	.062400
Nitric acid	Slight trace.
Total of mineral substances	.486660

"*Classification.*—Hypothermal waters; mixed bicarbonates and nitrates.

Comparison of the results of analysis.

		Grammes.
Total of mineral substance per liter, according to the above table		0.486660
Volatile substances:	Grammes.	
Oxygen	0.002509	
Nitrogen	.014800	
Carbonic acid, free	.167358	
Carbonic acid, in form of acid salt with carbonate of iron	.002530	
Carbonic acid, in form of acid salt with carbonate calcium	.027368	
Carbonic acid, in form of acid salt with carbonate of magnesia	.029543	
		.244108
Difference corresponding to the theoretical quantity of fixed substances		.242552
Fixed substances per liter determined experimentally		.248000
Discrepancy		.005448

"*Physiological effects.*—The commission, not knowing these effects, has not been able to take clinical observations which would serve to form an approximate opinion of the action of these waters. Owing to their limited mineralization and moderate temperature, it is supposed that their curative action may not be very pronounced, but that for this reason they ought to be employed in the treatment of certain diseases as a powerful auxiliary, both in drinking, through the quantity of salts contained, and in bathing, through their tepid condition.

"Natives who live in the vicinity of the spring do not forget to attach great importance to it, attributing to it numerous and extraordinary cures which have been without doubt the reason that in a certain noteworthy book these waters appear described in an exaggerated manner, and also with unlikely analyses which ought not to receive serious consideration.

"*Therapeutical indications.*—Considering only the chemical composition of these waters and their temperature, the following applications may be set forth: Convalescent pains, anemia, chlorosis, dyspepsia proper, gastrointestinal catarrh, and pelagra.

"*Uses.*—Bathing and drinking.

"*Bathing season.*—November to June."

After crossing the Botocan River at Pagsanjan the trail to Cavinte follows along the west side of the Boo River until within 200 yards of Cavinte, where it crosses the river by means of a large stone bridge.

The trail is on beds either of conglomerate or volcanic tuff all of the way. At Cavinte the red clay appears and together with the gray volcanic tuff constitutes the surface covering to Botocan Falls. Exposures of this red clay over 12 feet in thickness were observed.

The territory below Cavinte is characterized by sharp, steep ridges and narrow valleys, which decrease in size and steepness between Cavinte and Luisiana and beyond Luisiana the topography is that of a gently rolling country with well-rounded hills. From Luisiana to Botocan Falls the trail runs along, on, or near the top of the ridge until it strikes the Botocan River some 200 feet above the falls, where both a plank and a bamboo footbridge have been thrown across the stream.

The falls, whose energy it is proposed to transmit to Manila in the form of electric power, are nearly 200 feet in height. Before going over the cliff the stream divides into three parts, the two on the outside shooting straight over an abrupt shelf, while the middle one tumbles down the cliff for 15 feet before it clears the rock wall.

The upper 25 feet of the rock at the falls has the appearance of volcanic tuff, except that it exhibits a well-developed columnar structure with pentagonal cross sections predominating and shows flow lines which are absent in a typical tuff. Underlying this bed rock there are about 70 feet of a light-colored rock, probably a conglomerate, although no close examination could be made; then come 110 feet of black conglomerate, probably the same as that forming the Pagsanjan cliffs.

The river makes a sharp turn at the falls, the direction of the stream above being N. 68° E. and below N. 31° W. The east wall at this turn is semicircular in shape and 300 feet high. The upper 120 feet are apparently tuff and show the columnar structure very well.

Samples Nos. 18 and 19 are from the river bank immediately above the falls, where the rock shows at least two horizontal planes which may be the parting planes between different flows or eruptions. Although this material resembles cinder more than lava, it must have had sufficient fluidity to flow to some extent at least and on cooling to assume the columnar structure so common in basalt.

It may seem strange that with a comparatively soft tuff overlying a conglomerate composed mainly of hard igneous rocks a stream should be able to form a perpendicular cliff such as this, but this is made possible by the weak nonsiliceous binding material of the conglomerate. This cementing material closely resembles volcanic ash and no doubt the history of the conglomerate is interwoven with the history of the volcanoes of this region.

The elevation of Botocan Falls, as given by the Bureau of Engineering, is 1,080 feet. The highest point on the road between Luisiana and the falls is some 150 feet higher.

Between Botocan Falls and Majayjay the trail, running at right angles to the numerous small streams, alternately ascends and descends a series of steep hills. A large portion of this road was at one time paved with water-worn bowlders and in places the pavement is still intact. The stream beds are in tuff, the banks being usually vertical and 8 or 10 feet high.

From Majayjay, which has an elevation of 1,000 feet, the land slopes gradually to the lake, as though it were the gentle slope of an old volcano. Volcanic tuff is the only rock visible below Majayjay.

The town of Lumbang on the east bank of the Pagsanjan River is easily reached by banca from Santa Cruz. During the wet season a banca can pass over the low west bank of the river at this place, but during the dry season the banquero must either go down about 3 miles to the mouth of the river and then come up against the current or have the banca hauled over the 150 yards of intervening mud by a carabao.

Flat cocoanut and rice lands occupy the east side of the river for half a mile back of Lumbang, then the hills, 400 to 500 feet high, rise abruptly, leaving an opening for a small stream and deep canyon. I had time to ascend this canyon but a short distance and so far as I went found nothing but a black conglomerate, the same as shown at Pagsanjan gorge. A stream bed contains an immense quantity of igneous rock of different kinds and the walls are high but without vertical cliffs.

At Paete a short canyon runs back from the lake and terminates less than a mile east of the town in a cliff and waterfall 130 feet high. The cliff is composed of a fine-grained melaphyre (f. n.) which breaks into very sharp, irregular shapes. Sample No. 20 is a specimen of this rock taken from the foot of the cliff. Higher up the stone is somewhat more compact. Below this occurs about 50 feet of a more vesicular rock, although otherwise much the same.

The stream bed immediately below the falls is filled with bowlders of this same close-grained rock, but about 30 feet lower the channel is blocked with large bowlders of a feldspar-porphyry (f. n.) of a striking appearance. Some of these large cubes are 8 feet on a side and must have fallen from above, although about 50 feet lower down they form the bed rock of the stream for at least 300 feet and must have a thickness of 50 feet or more. This rock, of which sample No. 9 is a specimen, consists of feldspar phenocrysts up to one-half inch in length embedded in a fine slate-colored ground mass. The stone has a handsome appearance, but is wanting in strength and toughness, or, in other words, it is friable.

Mr. Roces, of Paete, has imported from the United States a complete equipment for a modern saw and planing mill and is now setting up the machinery. He intends to use the power of the falls to generate electricity with which to operate his machinery, although he also has a boiler and engine for this purpose. According to measurements of the flow of the stream made by Mr. Roces, the falls will generate 100 horsepower in the dry season, which will be just about enough to operate the mill.

The abrupt rise of the land one-half to three-quarters of a mile from the shore from almost water level to 400 feet or more begins at Pagsanjan and continues around past Limbuan, Paete, and Paquil, to Pangil, where it is terminated by the valley of the Salamboloc River. The land between Pangil and the Salamboloc River proper at Siniloan is perfectly flat and planted with rice.

On the west side of the Salamboloc the ridge of volcanic rock runs down to a point about a quarter of a mile southwest of Siniloan. Although numerous bowlders occur on the ridge, no exposure of the rock in place could be found.

A good road runs along the foot of the hills from Paete through Paquil and Pangil to Siniloan, which was traversed on foot, but no rock exposures of value were found.

The map shows Siniloan to be nearly due north of Pangil, but I found the magnetic bearings, taken with a Brunton pocket transit, to be N. 45° W. Matiquio is also shown much nearer to Mavatac than it should be. The bearing from Matiquio to Santa Cruz I found to be S. 15° E. instead of almost due south as shown on the map.

The low hills a mile northwest of Matiquio are covered with bowlders of melaphyre (f. n.), but the only exposure of rock in place showed volcanic tuff (sample No. 10 B). In Matiquio I obtained a small sample of white koalin clay (sample No. 11) which is reported to occur about 2 miles north of the barrio and a mile from the lake shore. It resembles the Los Baños clay in appearance and is used for the same purpose. This deposit has been recently located by some of the officials of Laguna Province, and I have since received good samples of this clay from Mr. Sherfey, supervisor of the province, who owns an interest in the claim. It is reported that this clay can be gotten to market more easily than the Los Baños product.

There is a foot trail from Matiquio to Jalajala which I desired to pass over in order to obtain a better idea of the structure of the main ridge on Jalajala peninsula, but it was found necessary to return to Santa Cruz.

The shore from Bagombong around the point to Jalajala shows no solid rock, as the land for some distance in from the shore is low and flat. Jalajala peninsula near the town of Jalajala seems to be composed of one material—a light-colored volcanic tuff, sometimes stained with iron oxide but more often nearly white.

On the southwest side of Mount Sunung-Dalaga about 2 miles northeast of Jalajala a landslide exposes this tuff for nearly 100 feet vertically. Although in small pieces it closely resembles hardened clay, it has no plasticity, shows no stratification, and vesicular fragments so characteristic of volcanic tuff in other parts of this region seem to establish it a tuff.

The shore for one-quarter of a mile along Bulabula point between Quisao and Pardia is strewn with melaphyre (f. n.) bowlders, but the rock in place is not exposed. The point is covered with small trees and is 25 feet high at the water's edge; 200 yards inland it is probably 100 feet above the level of the lake.

In a small bay just south of Quisao there are two brick kilns and a large dwelling house belonging to Mr. Collins, an American who has resided for many years in this vicinity. Ladrones have robbed the place many times and it is not occupied at present. My banqueros said that pieces of limestone found near the kilns came from the direction of Manila, but that it was also found in the hills to the east.

Blocks of volcanic tuff are being cut from a small ridge that extends to the water's edge a mile south of Tanay. It contains many lumps of hard. compact rock embedded in the soft material.

At the beginning of the hills three-fourths of a mile north of Tanay there are exposures of a dark-colored conglomerate which composes the surface covering for at least 1½ miles inland.

Only volcanic tuff shows near the shore from Morong until almost opposite the north end of Talim Island, when the basalt (f. n.) of which the north end of Talim is largely composed is found on the mainland.

An inspection of the south end of Talim Island failed to reveal a good building stone. The most southern part consists of the same basalt (f. n.) that the city of Manila quarries and crushes on the north end of the island.

The natives are industriously at work crushing the rock by hand into concrete size.

From a point opposite Malahi Island to Point Naglunglung on the east side of Talim the rock exposed along the lake shore is vesicular melaphyre (f. n.) of which samples Nos. 16 and 12 are specimens although No. 12 is not representative of the rock. At Naglunglung Point there is a compact leucophyre (f. n.) that shows for 100 feet along the shore and can be traced about 200 feet inland before it becomes covered with soil. It is firm and tough, but appears to have no jointing planes and to be of small extent.

The lake shore from Talim to Binangonan has several cliffs of volcanic tuff, but no crystalline rock was observed. On the point just north of Binangonan in the vicinity of the abandoned quarry of the city of Manila about 30 men are at work cutting out stone blocks. The large ones, some of them 3 feet by 18 inches are sold for tombstones, while the smaller ones, squared up and faced on one side, are used to pave alleys and for sidewalks. A stone 10 by 10 by 3 inches sells for ₱0.10 in Manila, while one 18 by 18 by 4½ inches brings ₱0.80. The rock is a vesicular basalt and consequently is a very poor stone both with respect to appearance and durability. Sample No. 13 is a representative specimen, while Nos. 14 and 15 show beautiful calcite crystals in cavities in the rock. The rock parts readily along a horizontal plane when in place and this parting is parallel to the flow lines of the rock.

A cross-sectional view herewith of the ridge given by the face of the old quarry shows 15 to 18 feet of this vesicular basalt (f. n.) overlying the dark compact rock which appears to be identical with the rock at the plant at Talim. The lower north side of the ridge is tuff.

The small workings of the stonecutters run 150 yards east of the old quarry. They work in horizontally almost at the top of the ridge, in no place having exposed a face more than 10 feet high.

About 3½ miles north of Binangonan on the trail to Antipolo is a bed of crystalline limestone which is transported on carabao sleds to several small barrios along the lake shore west of Binangonan and burned for lime. This bed of limestone is not over 200 feet wide and strikes due south. Its southern exposure lies due west of the mouth of the river at Morong. It is the first high ground on the west side of the valley, forming a secondary ridge parallel to a slightly higher ridge of igneous rock some 200 yards farther west.

From the topography of the region it would seem that a road could be built to the lake at Morong without great expense.

No stratification planes are apparent, but there are great cleavage planes roughly dividing the stone which dips west 70° from the horizontal. The rock weathers into rough, vertical columnar shapes which show no minor planes of parting. It is uniform in composition, strong and compact, but as it does not break into regular shapes it will be difficult to cut into dimensional stone. In samples Nos. 17 A and 17 B you discovered fossil remains which may be the *nummulites* that have been reported to be present in this rock by Baron von Richthofen.

CONCLUSION.

While this investigation does not prove conclusively that there is not a good building stone near the Laguna de Bay, it shows that the existence of such a stone is improbable.

The country near the lake shore from the Pasig River almost to Los Baños is low and flat land, so that no investigation of this area was necessary.

Diligent inquiry brought to light but one reported occurrence of a building stone. Mr. Sherfey, supervisor of Laguna, reported on the authority of one of his road foreman that in Spanish days a hard, dark-colored rock had been quarried on the Calamba side of Mount Maquiling. He has recently investigated and found that the stone was gotten from large bowlders of felspar-melaphyre (f. n.) in a small arroyo about a mile from the lake. From a sample of the rock (No. 20) it will be seen that it is not a first-class building stone.

The natives of Laguna Province especially seem to be well content and prosperous.

I was everywhere received very kindly by both Americans and Filipinos and am especially indebted to Mr. Sherfey, of Santa Cruz, for his assistance in many ways.

Respectfully submitted.

H. M. ICKIS, E. M.,
Field Assistant, Mining Bureau.

Mr. H. D. McCASKEY,
Chief of the Mining Bureau, Manila.

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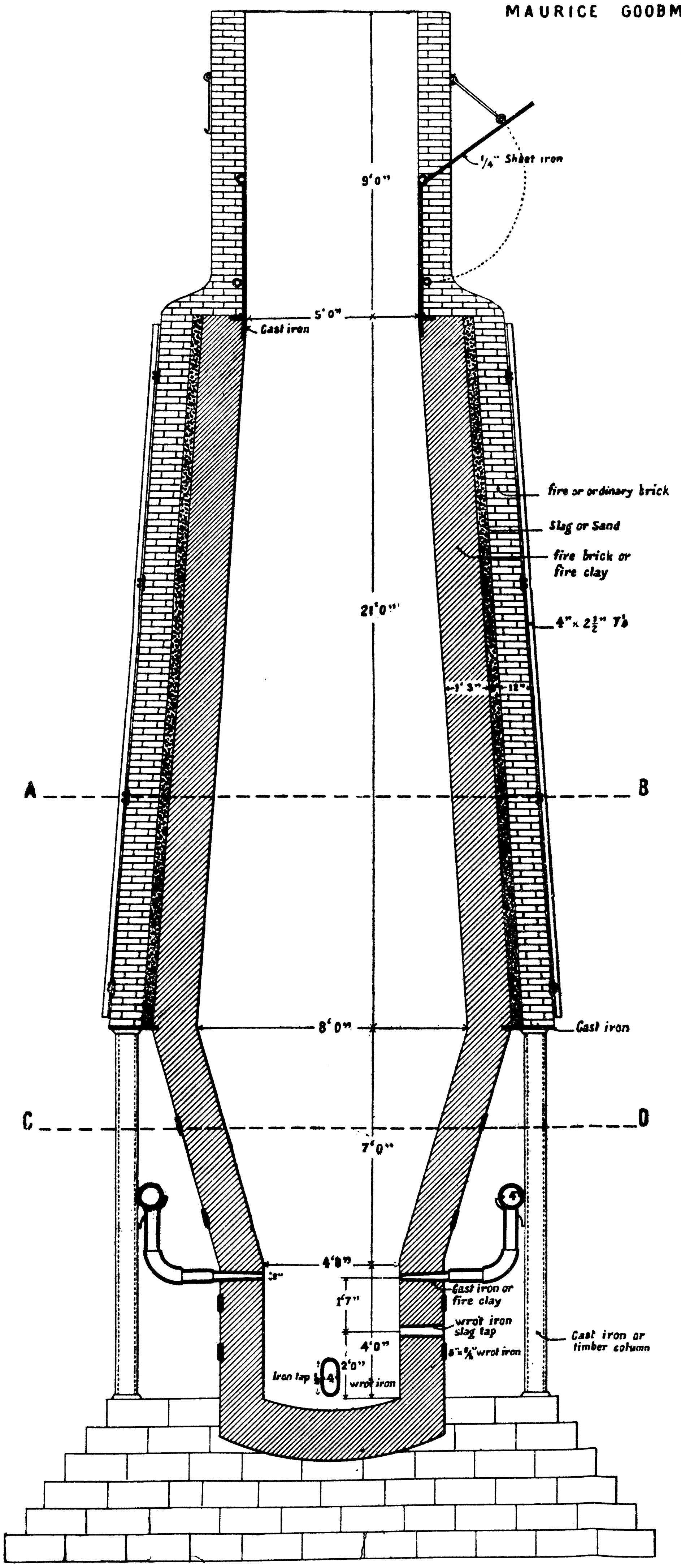
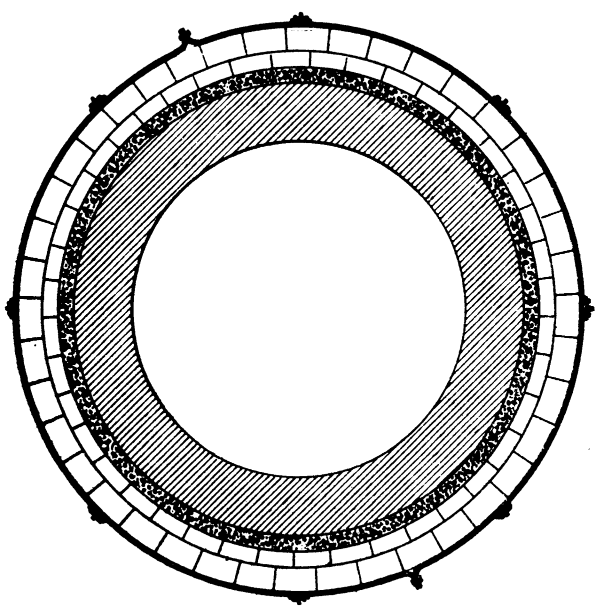
DEPARTMENT OF THE INTERIOR
MINING BUREAU
MANILA

DESIGN OF AN IMPROVED BLAST FURNACE
FOR ANGAT IRON REGION

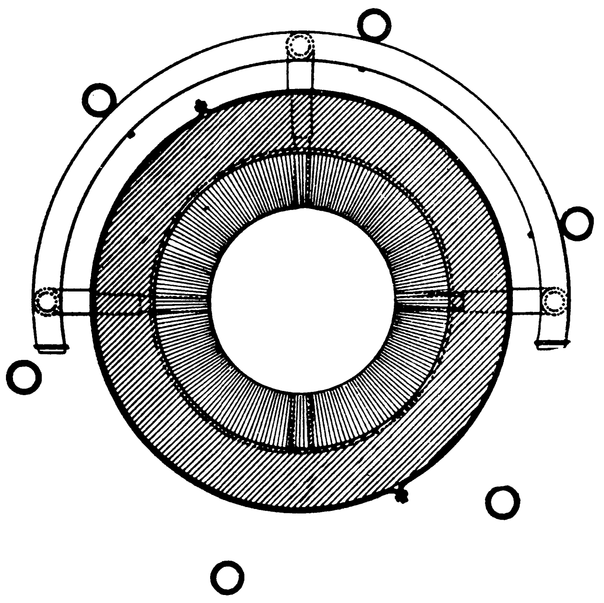
MAURICE GOOBMAN. FIELD ASSISTANT

1905

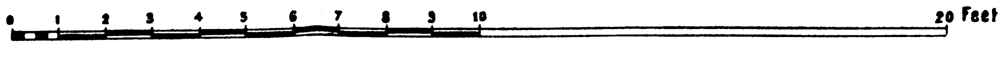




SECTION A. B.



SECTION C D.
Showing tuyeres and tap holes



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Oversized Foldout

Photo by A. J. Eveland.

PLATE I. OLD NATIVE WORKINGS IN GOLD DEPOSITS OF SUYOC, LEPANTO.

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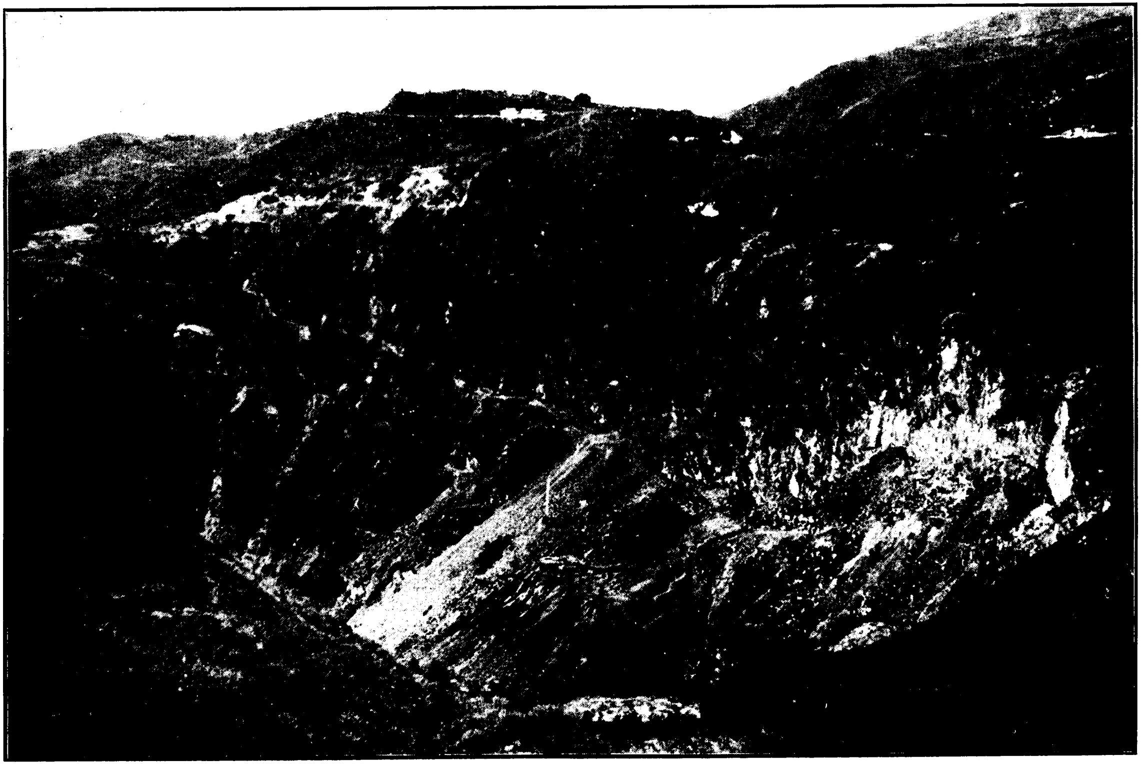

Photo by A. J. Eveland.

Plate II. COPPER DEPOSITS, MANCAYAN, LEPANTO.

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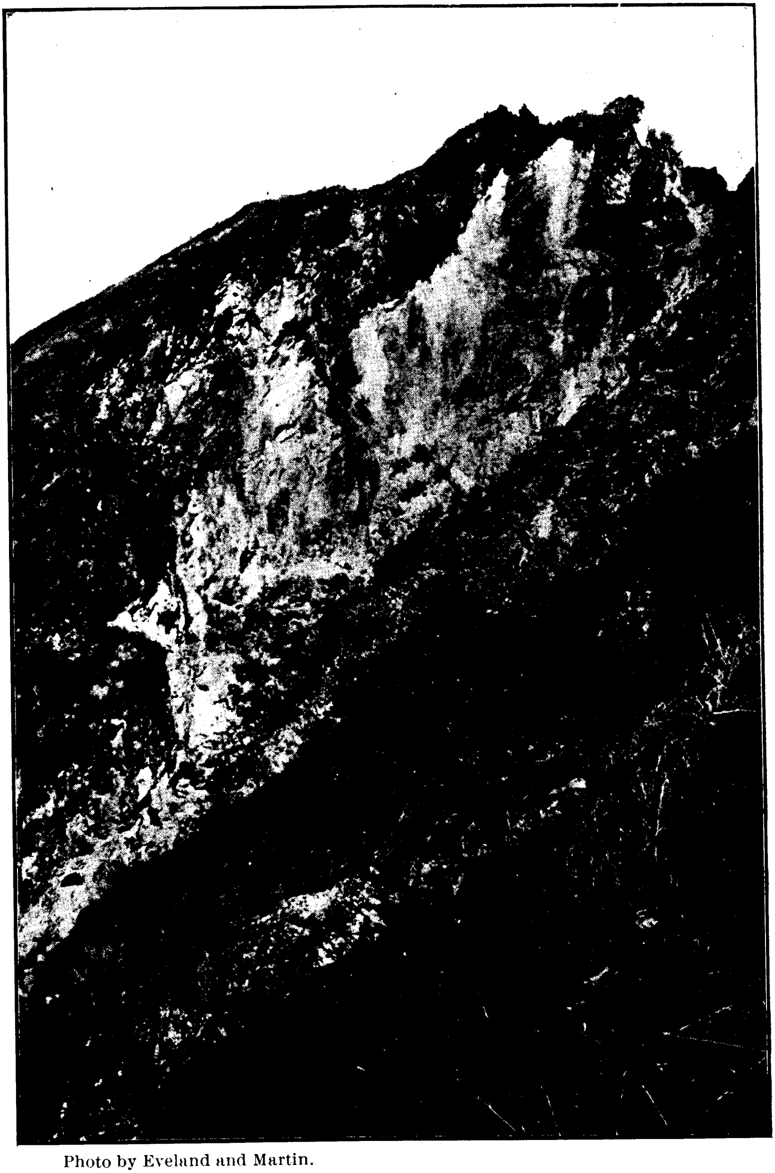

Photo by Eveland and Martin.

Plate III. IGOROT GOLD WORKINGS, ANTAMOK RIVER, BENGUET.

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PLATE IV. CLYDE'S CLAIM, ANTAMOK RIVER, BENGUET.

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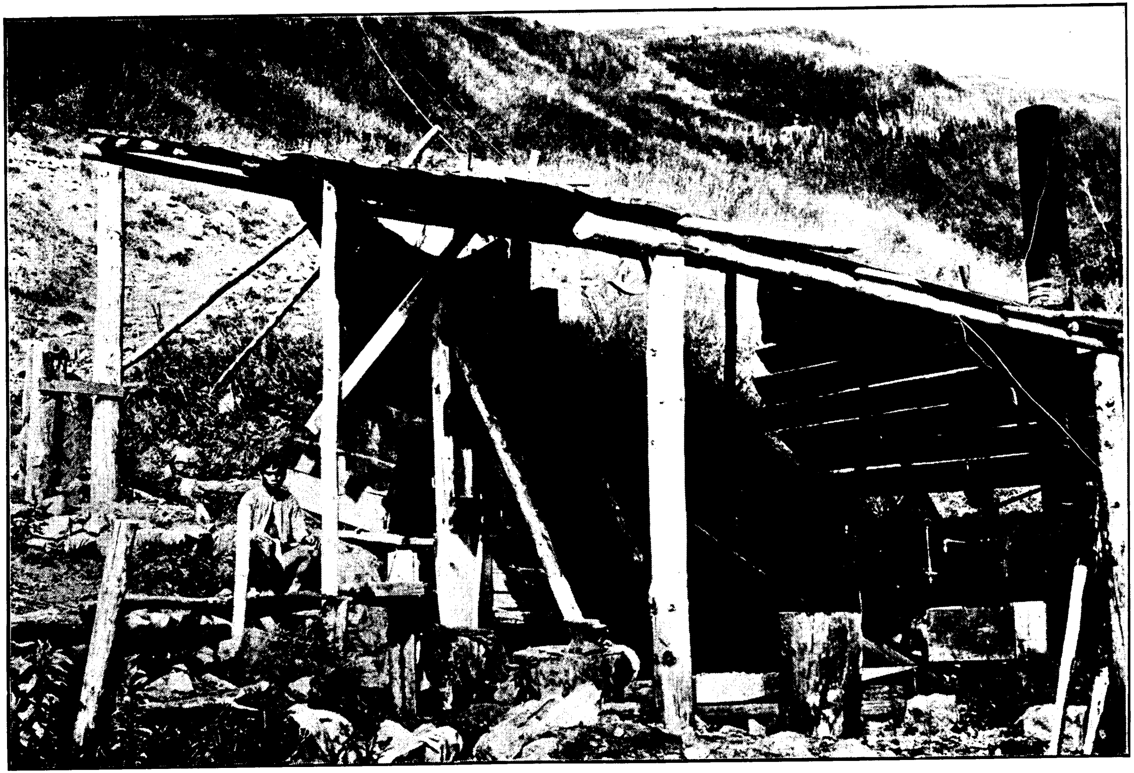

Photo by Eveland and Martin.

PLATE V. THE FIRST BENGUET GOLD MILL, HARTWELL'S MILL, KIAS HILL, BENGUET.

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PLATE VI. THE COPPER KING DEPOSITS, BUED RIVER, BENGUET.

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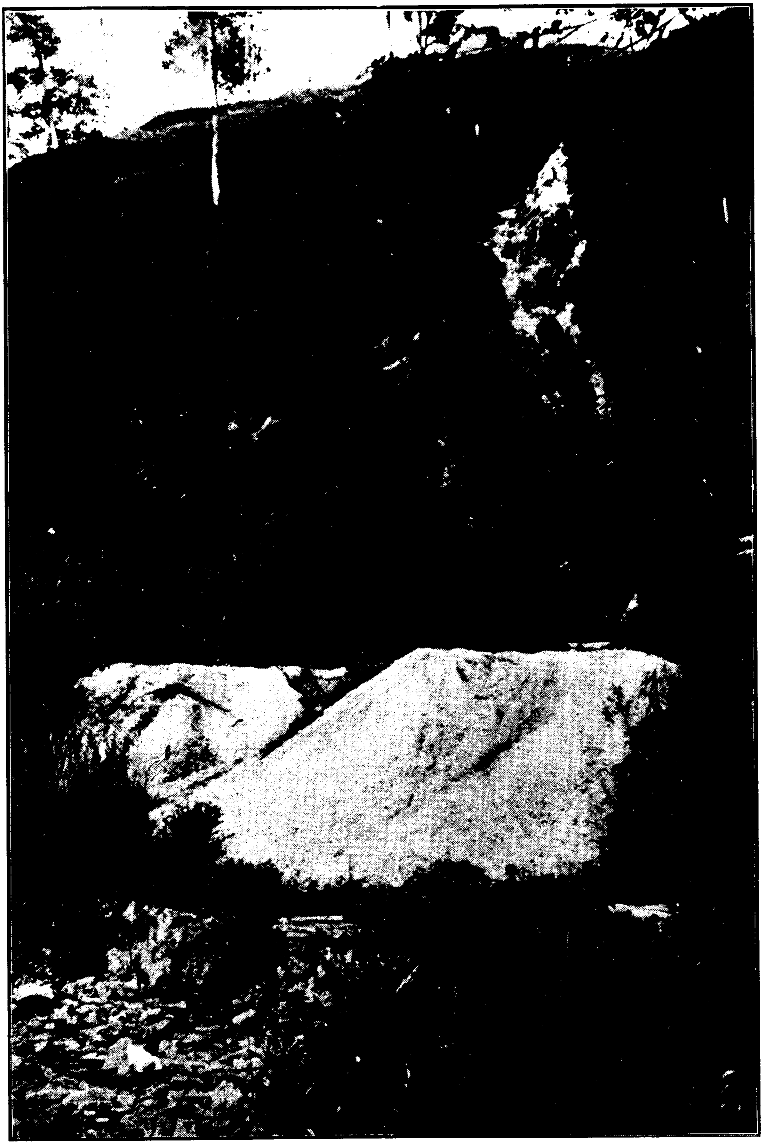

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PLATE VII. PETERSON AND CLYDE'S ORE DUMP, ANTAMOK RIVER, BENGUET.

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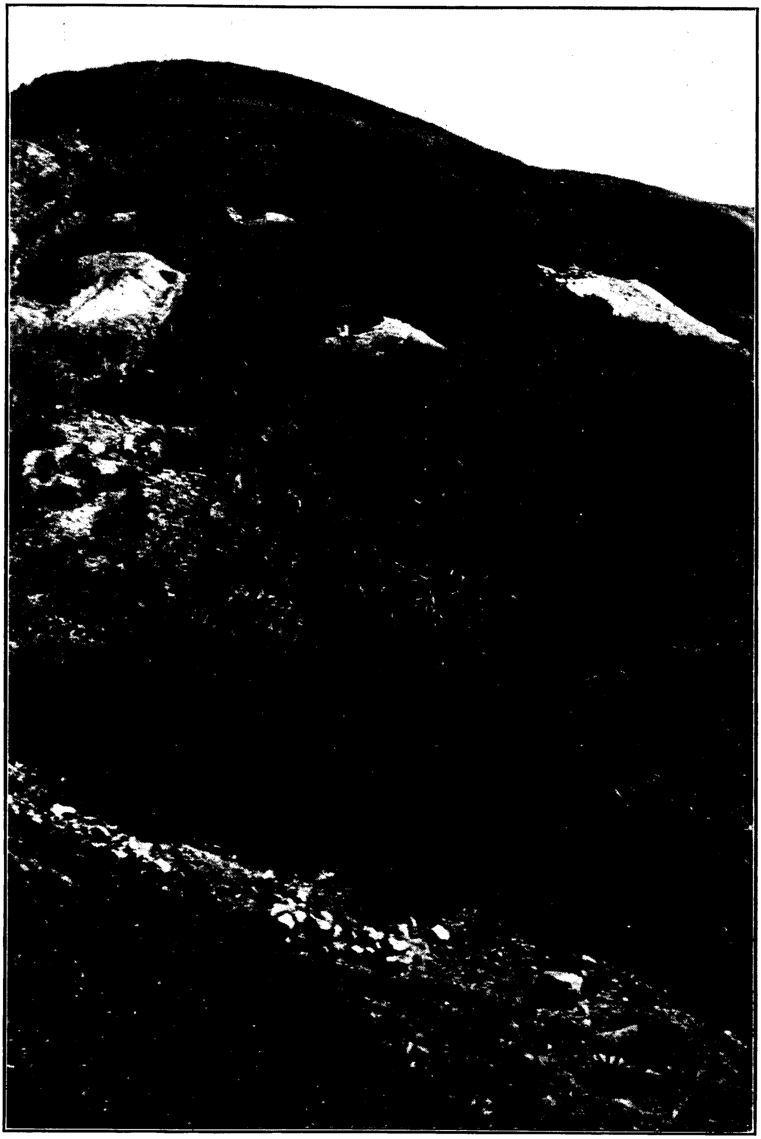

Photo by Eveland and Martin.

Plate VIII. HARTWELL'S CLAIMS, KIAS HILL, BENGUET.

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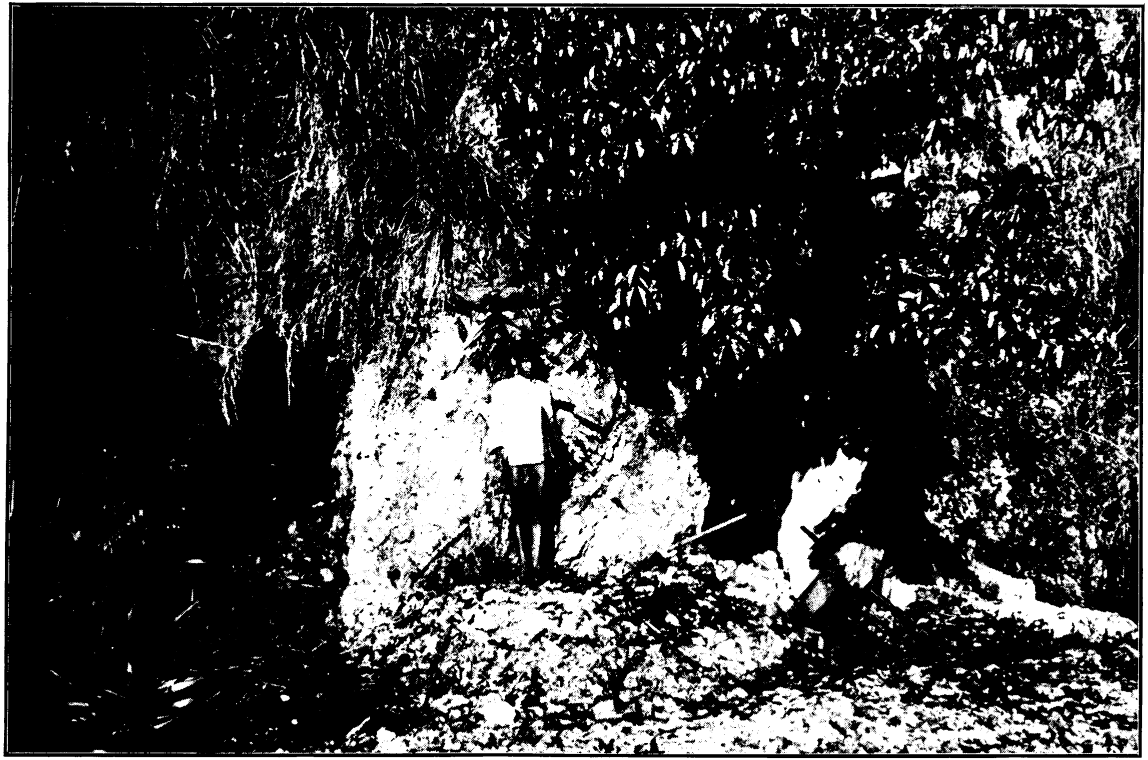

Photo by Eveland and Martin.

Plate IX. OUTCROP OF KELLY'S NAPTUNG LODE, GOLD RIVER, BENGUET.

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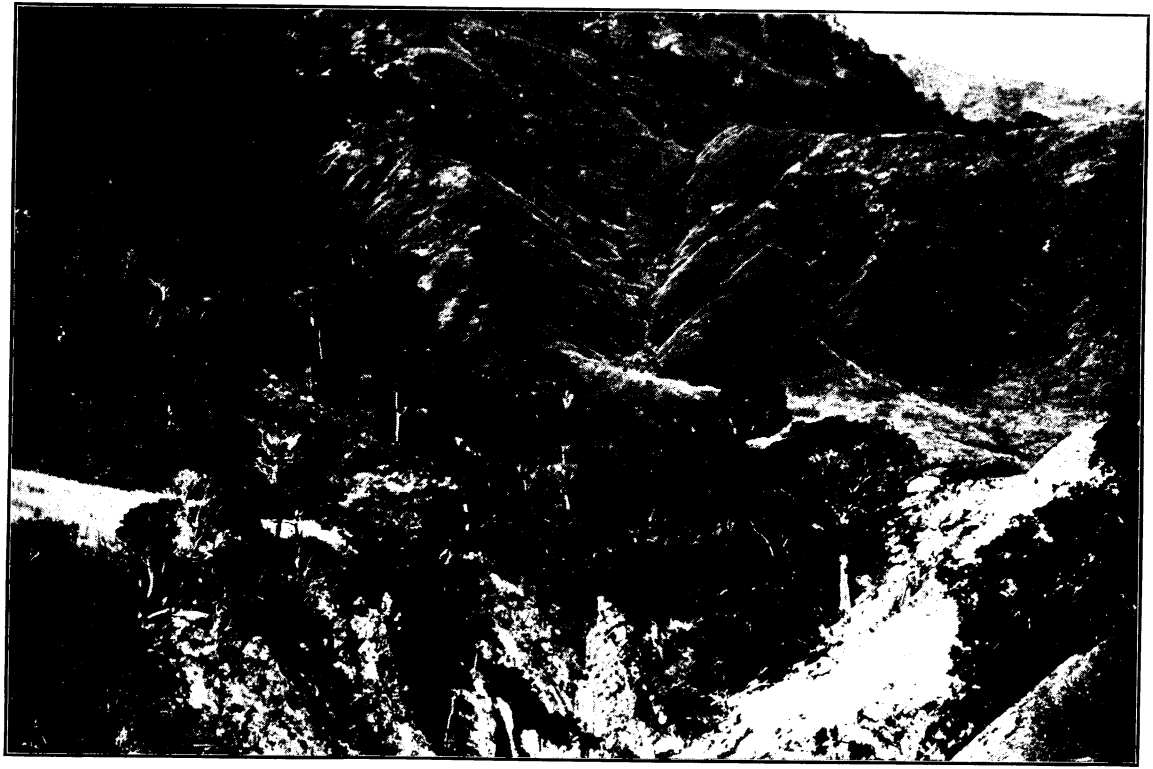

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PLATE X. BUED RIVER VALLEY AT CAMP IV, BENGUET.

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Photo by Eveland and Martin.

PLATE XI. AGNO RIVER VALLEY AT BUGIAS, BENGUET.

Photo by Charles Martin.

Plate XII. NATIVE BLAST FURNACE, ANGAT IRON MINES, BULACAN.

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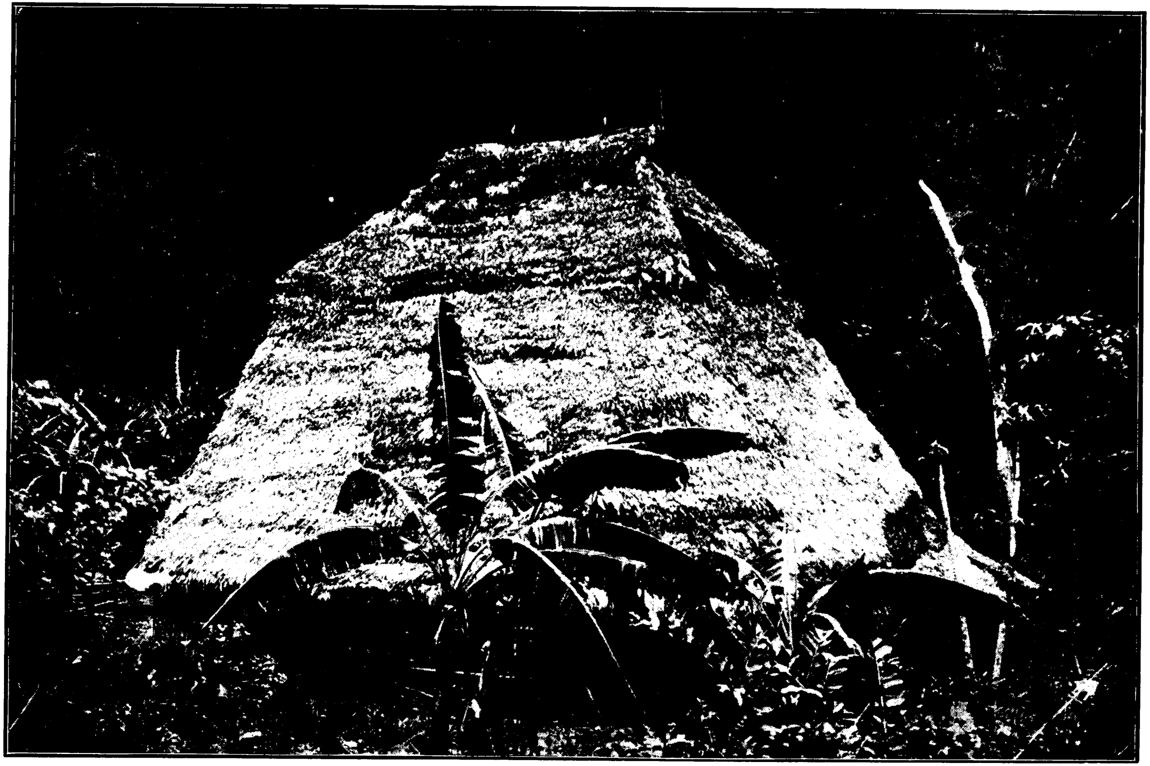

Photo by Charles Martin.

PLATE XIII. NATIVE SMELTER CAMARIN, ANGAT IRON MINES, BULACAN.

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